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Abstract

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Keywords: financial sector, bank lending, real estate exposure, subprime, conduits

JEL Codes: G01, G21, R00

1. Introduction

By mid–2006 real estate prices in the US began to plummet, triggering the US subprime mortgage crisis that led to a global financial crisis. While the main focus was on the fragility of the financial system (and, to some extent, the regulatory focus is still on how to re–establish a healthy banking industry), the initial policy reaction relied mostly on monetary tools. These measures proved to be not entirely effective due to the presence of excessive household debt coupled with decreasing home prices. The crisis may not have been as severe, it is often argued now, if those underlying problems had have been addressed in a first and foremost step (Mian and Sufi (2014)).[1]

German banks, too, experienced considerable loan losses and given solvency considerations consequently more binding capital constraints. This was largely attributed to their various exposures to the US real estate market. In addition to their direct lending to US firms in the real estate sector and to major subprime lenders, German banks also became exposed by providing liquidity support in the form of credit lines to their asset–backed commercial paper (ABCP) conduits.

The first banks that had to be bailed out by a government during the financial crisis were actually two German banks, IKB Deutsche Industriebank and Sachsen Landesbank. The deteriorating quality of their assets and the panic on the ABCP market forced these German banks to write off the liquidity lines they had provided to their ABCP conduits. These write–offs resulted in considerable losses on their balance sheets. In general, the Landesbanks' substantial exposures to US mortgage–backed securities through their ABCP conduits, which were higher than those of the big German banks, led to the collapse or bail–out of various Landesbanks.

Given these differences, we therefore investigate how each type of exposure in the US real estate market influenced domestic lending in Germany. We first suitably document the

[1] Allen and Carletti (2013) show that risk shifting and asset substitution can result in a bubble in real estate prices.

overall contraction in lending that occurred in Germany, then focus on the heterogeneity in the contraction taking place across banks and firms. We are mainly interested in studying whether – when home prices started to decline in the US – differences in bank exposures to the US real estate market started to determine bank lending in Germany according to firm risk.[2] In other words: Is there a flight to quality in domestic lending depending on the degree of the German banks' exposures in the US – following the decline in US home prices?

In terms of credit volume we find that banks that had a direct exposure to the US real estate sector contracted their lending in Germany by more following a decrease in US home prices than banks that did not have such exposure. This effect is both statistically significant and economically relevant. For example, a bank with a €1 billion exposure to the US real estate sector, and following a decrease by 5 index points (which is equal to two standard deviations) in the S&P/Case–Shiller US National Home Price Index, is estimated to contract its quarterly lending in Germany by 1.19 percentage points more than a bank with no such exposure. This is a large effect given that the mean (median) quarterly loan growth during the sample period equals –2.48 (–0.71) percent. And a bank with €1 billion conduit exposure is estimated to contract its quarterly lending in Germany by 1.47 percentage points more than banks without conduits in place following a decrease by 5 index points in home prices.

In terms of credit composition, we find clear evidence of a flight to quality. For example, a bank with a €1 billion exposure to the US real estate sector, and following a decrease by 5 index points in the S&P/Case–Shiller US National Home Price Index, is estimated to contract its quarterly lending in Germany to firms in riskier industry–region combinations (i.e., those with a 1 percentage point higher insolvency rate) by 4.01 percentage points more than a bank with no such exposure. A bank with €1 billion conduit exposure is estimated to contract its quarterly lending to such riskier industry–region pairs by 3.43 per-

[2] Our findings are unlikely to be driven by major regulatory changes as the sample period ends in 2009 whereas Basel III, for instance, developed by the Basel Committee to strengthen the banking sector, was not introduced before December 2010 (Basel Committee on Banking Supervision (2010)).

centage points more than banks without conduits in place when US home prices decrease by 5 index points. Overall, these findings imply that possible losses abroad may not only cut but also shift bank lending at home.

Our results thereby vividly demonstrate how the recent globalization in banking activities may be inevitably linked to financial stability. In particular, economic fluctuations in one country are transmitted to other countries through this bank exposure channel. As the largest European economy and as a bank–based system, where bank financing plays a crucial role for corporations of all sizes, Germany is particularly interesting to pursue this analysis. These characteristics of the financial system enable us to focus on how affected banks change their lending towards domestic firms, which has an influence on the real economy as well.

We are clearly not the first to study (and for identification purposes 'exploit') the international transmission of shocks through the banking sector. However ours is the first paper to investigate the type and the level of the exposures to the US real estate market by non–US banks and how these exposures influence both the volume and the composition of local lending depending on the US home price shock. In terms of identification, our approach is superior to extant work on this topic because we use the actual real estate exposures to the US, which is "ground zero" for the financial crisis, and because we focus on the initial exogenous shock in the US home prices in combination with those "ground zero" exposures. Additionally, we study lending taking place in another country (different from the crisis country) with the information from a comprehensive credit register providing strong controls for local credit demand.

Our research follows the seminal work by Peek and Rosengren (1997) and Peek and Rosengren (2000) who show that when parent banks are faced with a (funding) shock, this can negatively affect lending by their foreign affiliates.[3] In particular Peek and Rosengren

[3] Recent research confirms that, during the global financial crisis, global banks transmitted shocks across borders through their local affiliates (see, among others, Cetorelli and Goldberg (2011); Cetorelli and Goldberg (2012); Albertazzi and Bottero (2013); Claessens and van Horen (2013); Cull and Martinez Peria (2013); Allen et al. (2014); Bertay (2014); de Haas and van Lelyveld (2014); Ongena, Peydró and van Horen (2015); and Acharya, Afonso and Kovner (2017)).

(1997) identify a supply shock to bank lending in the US through US branches of Japanese banks, which was caused by the decline in Japanese stock market values. Unlike the previous studies trying to examine the relationship between capital ratios and the overall volume of lending, their study actually disentangles loan supply from loan demand by focusing on the transmission of the capital effects of the Japanese stock market declines. Their paper documents that the Japanese banks' capital ratios significantly determine its commercial and industrial lending in the US. Using similar data, Peek and Rosengren (2000) investigate the change in commercial real estate loans in spatially separated markets, which enables them to examine the impact of this loan supply shock on the real economic activity in the US.

A recent paper (and closest to ours) is a paper by Puri, Rocholl and Steffen (2011). They investigate the impact of the financial crises on the credit supply of German savings banks. Here, the transmission occurs through savings banks' holdings in Landesbanks that were exposed to subprime mortgages.[4] This mechanism is somewhat different from the one in Peek and Rosengren since an external financial shock is transmitted to a domestic market through the exposure of the domestic banks. For that reason, it becomes even more important and potentially more difficult to isolate the loan supply effect. Puri, Rocholl and Steffen (2011) disentangle supply from demand effects by employing information coming from the loan application process. The authors find that affected savings banks reject more loan applications than non–affected banks. However, close bank–firm relationships help to mitigate the loan supply shock.

A number of features distinguish our paper from theirs. First, having access to unique and confidential supervisory data, we know the actual time–varying exposures to the US real estate market (direct lending to the US real estate sector, to major subprime lenders, and conduit exposures) of all German banks. Combined with the US home price shock,

[4] Other papers studying the international transmission through the asset side of the banks include De Haas and Van Horen (2013) and Popov and Van Horen (2015). The former paper examines syndicated loans and finds that crisis–related write–downs negatively affected cross–border bank lending. The latter paper finds that large holdings of impaired sovereign debt negatively affected bank lending during the European sovereign debt crisis. Cuñat, Cvijanovic' and Yuan (2013) study the domestic transmission of real estate price shocks within the US using bank balance sheets. Ahrend and Goujard (2015) document that shocks to bank balance–sheets are able to predict systemic banking crises in debtor countries.

these exposures to the US real estate market allow us to identify possible (but at the time not yet publicly observable) bank losses. In contrast, Puri, Rocholl and Steffen (2011) rely on ex post publicly reported distress at three Landesbanks that led to a decline in the value of equity held by savings banks present in their loan data set. Thus our data set enables us to assess the time–varying effects of various types of German bank exposures to the US real estate market throughout the entire crisis period, not just the presumed (though plausible) impact through indirect linkages within parts of the German banking system.[5]

Second, to identify the changes in lending we rely on credit register data that cover the entire banking sector in Germany, not just savings banks. We match this data with bank and market characteristics. Finally, we examine the resultant changes not only in the aggregate volume but also in the composition of bank lending in Germany across corporations, industries and regions as we want to investigate whether there is a 'flight to quality' in lending in Germany for those banks that were more exposed to the US real estate market.

In this respect, our paper also contributes to an extant literature that examines the flight to quality or loan strictness following negative shocks affecting banks (Lang and Nakamura (1995); Bernanke, Gertler and Gilchrist (1996); Murfin (2012); Becker and Ivashina (2016)), or documents bank risk–taking following expansionary monetary shocks (e.g., Jiménez et al. (2014); Ioannidou, Ongena and Peydró (2015); Dell'Ariccia, Laeven and Suarez (2017)). These also include studies on bank security portfolios during the crisis where a similar pattern is observed through the purchase of high quality assets by banks. Hildebrand, Rocholl and Schulz (2012) for example investigate banks' investment strategies in Germany and find that banks prefer to purchase securities that are eligible as collateral when borrowing from the ECB. This behavior is more pronounced for less healthy

[5] Not all savings banks were directly exposed to the US real estate market, however they were affected through their link with the Landesbanks during the crisis. We, on the other hand, focus on the initial shock and not on the spillovers to other banks. However, since we cover the crisis period as well, we re–estimate our model by excluding the savings banks from our sample. The results remain qualitatively unchanged.

or large banks, and for banks that are exposed to Greek bonds. Beber, Brandt and Kavajecz (2009), on the other hand, examine whether investment decisions are driven by quality or liquidity concerns, and they find that during distressed times, investors prefer liquidity rather than credit quality. In that respect, both papers point to the importance of liquidity in investment decisions as well. However, changes in lending behavior are more likely to be driven by default risk only, especially if securitization is not an option. This feature distinguishes our paper from that strand of literature.

The remainder of our paper is organized as follows. In Section II, we discuss the various exposures German banks have in the US and their lending to firms in Germany. In Section III we describe the data and the definition of the variables of interest. We discuss the methodology and present the main estimation results in Section IV. Section V concludes.

2. Portfolios of German Banks

Asset–Backed Commercial Paper (ABCP) conduits set up by German banks performed maturity transformation by purchasing long–term assets and issuing asset–backed commercial paper, a short–term debt instrument which is often used to raise capital. The ABCP were primarily sold to money market funds (MMFs) and rolled over at regular intervals. Nevertheless, ABCP conduits used to be off–balance sheet vehicles and represented the agents of the “shadow banking” market, which appeared to be less regulated. Therefore, German banks could hold assets in their ABCP conduits without providing a sufficient amount of the required capital.

ABCP conduits were designed to protect investors from declines in the market value of the underlying assets. Sponsoring banks provided liquidity support to their ABCP conduits. According to Moody’s (2007): “Most programmes have 100% committed liquidity support that can be drawn to repay ABCP up to the par value of non–defaulted assets, regardless

of market value." In cases where ABCP conduits experienced difficulties, credit risk attributed to the ABCP conduits effectively put a strain on their parent banks.

Being a safe haven for investors before the crisis, ABCP conduits played a central role in the financial crisis 2007–2009 when news about the deteriorating quality of US subprime mortgages roiled the financial markets and the market for ABCP froze with risk–averse investors being unwilling to purchase and roll over maturing ABCP (Acharya and Schnabl (2010); Kacperczyk and Schnabl (2010)).[6] [7]

At the end of July 2007 the US subprime mortgage crisis reached its first victim in Germany. On July 31th, 2007, Frankfurter Allgemeine indeed reported about the failure of the IKB Deutsche Industriebank AG – a bank which financed mainly medium–sized enterprises. IKB failed on a large credit line provided to its conduit Rhineland Funding Capital which amounted to €12.7 billion. The IKB failure unfortunately did not remain an isolated incident.

In the mid of August 2007 the next bank – SachenLB – made the headlines in the newspapers. On the August 22nd, 2007, the Financial Times wrote: *"SachsenLB, a publicly–owned Landesbank, or a state bank, became the second German financial institution in three weeks to be forced to accept an emergency rescue, with fellow savings banks taking over a €17.3 billion credit facility."* As quoted also by the other newspapers such as Franfurter Allgemeine on August 10th and later by Handelsblatt on the November 9th the 24th biggest German bank SachsenLB had been running one of the world biggest conduits called Ormond Quay. The financing needs of SachsenLB raised to €17.5 billion and exceeded its own capital by more than ten times.

The Financial Times titled its article "'Not uncritical' Subprime exposure drags down German banks" and characterized the situation in Germany as the following: *"The crisis focuses on German public banks, in particular the Landesbanks … ."*[8] As the reasons for

[6] On 31 July, 2007, the news about the bankruptcy of the two Bear Stearns' hedge funds invested in subprime mortgages reached the market. On 7 August 2007, the French Bank BNP Paribas pronounced its withdrawals from its three funds due to an inability to judge the "fair" value of their holdings.

[7] Acharya, Schnabl and Suarez (2013) document that it was banks and not investors that were negatively affected because banks had insured outside investors by providing explicit guarantees to conduits.

[8] The Financial Times published the list of German banks and their conduits with the amounts of credit facilities provided. From the list it is possible to observe that not only the big banks but also a lot of Landesbanks had been involved in this

the Landesbanks to be involved in such risky activities the Financial Times pointed on the one hand to the effects of rising competition and capital requirements and on the other hand to the declining earnings opportunities in the home markets.

Between August 2007 and the Lehman Brothers' bankruptcy in September 2008, the ABCP market was seriously stressed. In this period, the total value of ABCP outstanding decreased by 37 percent, from $1.18 trillion to $745 billion. However, the cost of issuing overnight ABCP relative to the US Federal Reserve Funds rate also jumped from 10 to 150 basis points after the news of the withdrawals from BNP Paribas. On September 16th, 2008, the Reserve Primary Fund – a large MMF – announced considerable losses on its holdings of Lehman Brothers' CP. This, in turn triggered a run on the MMF industry and led to the reduction of holdings of all types of CP by MMFs. After Lehman Brothers' collapse, German banks, which were already weakened by the need to meet their obligations on maturing ABCP, came under further pressure.

Credit growth in Germany has been characterized by various fluctuations since 2002. The annual growth rate of lending to domestic firms rose sharply from –0.1 percent in May 2007 to 3.8 percent in July 2008, whereas a remarkable drop was observed starting only from the third quarter of 2008 onwards (Deutsche Bundesbank, *Monthly Report*, 9/2009). The annual growth in lending declined by 2.7 percentage points to 1.1 percent between July 2008 and July 2009. The rest of the euro area, on the other hand, witnessed a sharper decline in lending than Germany, and also at an earlier point in time – at the end of 2007. The slowdown in lending is found to be situated in the non–financial industry. Growth in lending declined sharply especially for those banking groups that were hit particularly hard by the global financial crisis.

kind of risky activity. SachsenLB, LBBW (Landebank Baden–Württemberg), WestLB and BayernLB were among the Landesbanks with especially large engagements.

3. Data and Variables

3.1 Data Sources

We employ a unique matched firm–bank level dataset that contains quarterly information from the 1st quarter of 2005 to the 4th quarter of 2009. The data combine five databases: (1) the Deutsche Bundesbank's credit register (MiMik), (2) Moody's ABCP Query, (3) bank balance sheet data (Bista, BAKIS), (4) regional firm insolvencies per industry, and (5) home price indices (S&P/Case–Shiller). These data sources make it possible to observe the individual lending behavior of German banks to domestic firms, and to combine this information with the exposure of German banks to the real estate sector in the US, to subprime lenders in the US, and to their conduits engaged in the US market, as well as to use the firm and bank–specific information.

The credit register (MiMik) is the main data source for the individual exposures of German banks to firms.[9] The credit register contains information on large exposures of €1.5 million (formerly 3 million Deutsche Mark) and above.[10] Therefore exposures to small and medium–sized firms might be underrepresented in this database. However, if the sum of the exposures to firms in a "borrower unit", i.e., a group of affiliated companies, exceeds the threshold of €1.5 million, the individual exposure to a firm in that group is reported, even if it is a very small exposure. This reporting partly abates the extant bias in the credit register towards medium and large–sized firms. Moreover, large firms play a relatively more important role in our analysis since they represent a larger portion of the borrowing in total. At individual level, large firms potentially borrow from large banks in large volumes that may be adjusted swiftly. Therefore, we believe that the threshold helps to make our

[9] Details on the credit register can be found in Schmieder (2006), and in published work by Schertler, Buch and von Westernhagen (2006), Hayden, Porath and von Westernhagen (2007) and Ongena, Tümer–Alkan and von Westernhagen (2012), for example. The Bundesbank also maintains a website with papers based on its credit register. Recent prominent examples include, e.g., Behn, Haselmann and Wachtel (2016) and Haselmann, Schoenherr and Vig (2017).

[10] If exposures of €1.5 million or above existed during the reporting period but are partly or fully repaid, the remaining exposure is reported even if the amount is zero. We take the actual amounts of the exposures into consideration.

control group more comparable to the group of banks that were exposed to the US real estate market, in effect similar to a matching exercise.

Bank exposures to firms in the credit register are defined fairly broadly, e.g., they include not only corporate loans but also corporate bonds and other securities which belong to the non–trading stock.[11] In the credit register we are able to distinguish between on–balance sheet and off–balance sheet items.[12] We choose to use only on–balance sheet positions, since the inclusion of off–balance sheet exposures leads to an overstatement of the actual exposures due to guarantees provided by banks (to other banks for exposures that were already covered in on–balance sheet items).

Based on individual bank exposures to firms, banks and other financial institutions, the credit register covers both domestic and foreign exposures and contains the information on country code and industry classification within a particular country. This structure of the credit register allows us to identify both individual bank exposures to the real estate sector as well as to the top subprime lenders in the US, and enables us to study the impact of these exposures on the lending of German banks to domestic firms. The credit register contains also information on firm quality, however for restricted periods in the sample. Therefore, we augment the available information with the industry–level number of firm defaults within particular German Federal States from the Federal Statistical Office. This information on the industry number of firm defaults (*Insolvency*) makes it possible to differentiate between the lending behavior of German banks towards firms with high and low quality.

The second database we use is the Moody's ABCP Query. From this database we take the information on all important conduits of German banks and on the amount of liquidity

[11] For a more detailed definition of the bank exposures, see Section 19 of the Banking Act (The versions applied before 01.01.2014). The following items are deemed not to be bank exposures: exposures to German central and local governments and communities, securities in the trading stock, undrawn loan commitments, shares in other enterprises etc. For a more detailed definition on the exceptions of the bank exposures, see Section 20 of the Banking Act (The versions applied before 01.01.2014).

[12] For example, lease receivables, mortgage loans, publicly guaranteed loans, and inter–bank loans (with a residual maturity of up to one year) were listed separately before 2008 under on–balance sheet activities. Off–balance sheet items included derivatives (other than written option positions), guarantees assumed to cover these and other off–balance sheet transactions (*Deutsche Bundesbank*, 1998). However, since 2008 the structure of items listed separately has changed to some extent. But the main structure due to which we are able to distinguish between on–balance sheet and off–balance sheet activities has remained unchanged.

provision of German banks to their conduits. However, this information is available in the Moody's ABCP Query only starting in 2007. For 2005 and 2006 we hand–collect this information from two Moody's publications: "A Performance Overview for EMEA ABCP conduits" and "A Program Review for US conduits". This information allows us to study the impact of the German bank exposure to their conduits on lending behavior to domestic firms. Similar to the real estate exposure in the US and exposure to the subprime lenders in the US (taken from the credit register), the German bank exposure to their conduits is quarterly and is aggregated at the bank level.

We borrow the majority of our bank–specific variables from the monthly balance sheet statistics (Bista) and some of our bank–specific variables from BAKIS. BAKIS is the Information System, which is shared between the Deutsche Bundesbank and BaFin (the German Federal Banking Supervisory Office). It contains the bank balance sheets for all German banks. We select the monthly balance sheet statistics and match them with the credit register on a quarterly basis. Some risk indicators, such as, e.g., non–performing loans, are not available in Bista and we extract them on a yearly basis from BAKIS.

Finally, to capture the price developments in the US real estate market, we access the S&P/Case–Shiller Home Price Indices.

3.2 Sample

Over the time period from the 1st quarter of 2005 to the 4th quarter of 2009 we consider 2,031 banks that provide domestic balance–sheet loans to 336,990 firms in Germany. In total we have 3.9 million bank–firm–quarter observations of domestic on–balance–sheet lending. However, a number of bank mergers took place during this time period. We carry out a merger correction procedure by creating a new separate bank after the merger.[13] Of the 2,031 banks involved, 90 banks have direct exposure to the US real estate sector, 142 banks have direct exposure to subprime lenders and 20 banks have conduit exposure. In a

[13] Our approach is based on separating the pre–merger banks from the merged bank. In the end, we have three banks, which are treated independently from each other. We repeat this procedure as often as a merger takes place. Each time a newly merged bank receives a new identification number, we drop the target banks in that year (or quarter).

final step we match the datasets discussed in Section 3.1, and we end up with 1,664,262 bank–firm–quarter observations available for the whole set of variables for our main model.

[Tables 1 and 2 Here]

Tables 1 and 2 contain variable definitions and their summary statistics. The latter suggest that the sample selection is fortunately minimal. It is also worth noting that the change in log domestic lending has negative mean and median values: –0.025 and –0.007, respectively. In Figure 1 Panel A and B, we present the mean values of bank exposures, US home prices and domestic lending growth over time. We observe that as home prices decrease lending growth in Germany contracts as well, which is more pronounced for banks that were exposed to the US real estate sector.

3.3 Bank Exposure to Real Estate, Subprime and Conduits

German banks were engaged in at least three ways in the US real estate market: Some banks had direct (regular) exposures to the US real estate sector on their balance sheets, some banks had exposures to subprime lenders in the US, and some banks had asset–backed commercial paper (ABCP) conduits in place.[14]

[Table 3 here]

Table 3 gives a detailed overview of German banks' portfolios based on the credit register data by distinguishing between on and off–balance sheet exposures in 2007. The upper panel of the table provides the regional distribution of exposures to the real estate sector, including Greece, Ireland, Portugal, Spain, offshore centers, the US and all foreign

[14] Ferreira and Gyourko (2015) document that the crisis was more due to prime borrowers, in contrast to the common belief that it was caused by subprime borrowers. We also consider this finding when classifying the exposures in the analysis. We start the analysis by investigating the direct exposure to the US real estate market that includes prime borrowers as well. After that we assess the role of the exposures to subprime lenders in the US.

countries.[15] We can clearly see that German banks' exposure to US firms in the real estate sector was significantly higher than exposures to any of the other countries' firms in the same sector. Whereas US real estate exposure exceeds €30 billion, the second highest exposure, which is to offshore centers, totals only €13.6 billion, while the third highest, which is to Spain, equals €10.6 billion. Moreover, US real estate exposure was potentially the first to be struck by a collapse in home prices and this exposure will therefore experience the "cleanest" (identifiable) shock to real estate during the crisis. We also note that we ended our sample period in 2009, in order to have a cleaner setting and not to include the beginning of the sovereign debt crisis.

Table 3 also breaks down the exposures by three types, i.e., on and off–balance sheet exposures and derivatives. The fraction of the on–balance sheet exposures ranges from 87 to 92 percent for all three types of exposures, which explains our later approach of focusing on these on–balance sheet exposures. The rest of the table lists the outstanding loans to US banks (€157 billion) and the total exposure to offshore centers (€148 billion). It is not surprising that the structure of lending to banks differs from the direct exposure to the real estate sector as the former consists of similar shares of on and off–balance sheet exposures due to a higher share of derivatives.

[Table 4 here]

The bulk of the German banks' engagement in the US subprime mortgage market took place through the investment activities of their ABCP conduits, however.[16] Table 4 provides the US real estate, subprime and conduit exposures for all German banks in 2007Q2. For the mean bank among the 1,547 banks in our sample, direct real estate exposure in 2007Q2, for example, was equal to €17.7 million, exposure to major subprime

[15] During the Eurozone crisis, Greece, Ireland and Portugal received bail–out funds of €148.6, €54.9 and €61.4 billion, respectively. Another Eurozone member, Spain, experienced problems in the real estate sector reflected in decreasing home prices. Finally, exposure to offshore centers is an indication of SPV exposures.

[16] Since the credit register does not contain exposures to ABCP conduits, we do not include the information on those exposures in Table 3. The data on ABCP conduits comes from Moody's ABCP Query and is discussed in Table 4.

lenders equal to €1.3 million, and conduit exposure equal to €81.3 million. Among the 41 banks with real estate exposures, the mean (median) exposure amounted to €666.8 (€161.8) million; for the 78 banks with subprime exposures, the mean (median) exposure was equal to €25 (€5) million; while for the 13 banks with conduits, the mean (median) exposure was equal to €9.7 (€5.7) billion. Relative to total assets, real estate exposure averages to 0.92 percent whereas ratios for subprime exposure and conduit exposure are documented as 0.27 percent and 2.83 percent, respectively. While acknowledging that only a small number of banks were exposed, we also note that these banks are lenders to a much higher number of borrowers compared to the rest of the banks without exposure. This is observable in the number of observations of the exposed group to the total number as ranging from 25 to 35 percent (see the later Table 6 for example). In other words, these exposed banks have an important role in overall domestic lending.

[Table 5 here]

In Table 5 Panel A, we present the correlations between US real estate, subprime and conduit exposures. They are all highly correlated but the highest correlation is observed between the US real estate and conduit exposures. In Panel B, we classify banks based on banking group and exposure type in 2007Q2. We observe that all big banks were exposed to the US real estate market, while 11 out of 12 Landesbanks were involved in lending to this sector. Surprisingly, even a few savings banks and cooperative banks had US real estate exposure whereas 33 savings banks and 23 cooperative banks had lending exposures to US subprime lenders. As expected, those two groups were not involved in providing liquidity to conduits.[17]

When measuring bank exposures to financial shocks in the US, we differentiate between direct and indirect bank exposures. Direct exposures are taken from the credit regis-

[17] In robustness we re–estimate our main models excluding savings banks (and then also cooperative banks). We will discuss the unaffected results later.

ter and appear *talis qualis* on banks' balance sheets. Under indirect exposure, we consider the amount of liquidity that German banks provided to their conduits before and in the aftermath of the US crisis. These exposures are considered to be off–balance sheet and thus do not directly appear on banks' balance sheets in the event that banks' conduits run into trouble.

More precisely, we define the three different bank exposures in the US as follows. The first one is the *Log US Real Estate Exposure*$_{it}$ which is the logarithm of the total exposure of bank *i* in a particular quarter *t* to the US real estate sector.[18] More specifically, the variable is defined as the logarithm of one plus the exposure in order to retain the banks in the sample that do not have any exposure to the US real estate sector. We use the same approach for the other exposures as well. This information is taken directly from the credit register. *US Real Estate Exposure*$_{it}$ is accumulated across individual bank–firm level exposures to the US real estate sector (and therefore varies at the bank level but does not vary across firms borrowing from the same bank when we assess the changes in lending at the bank–firm level).

We also define *Log US Subprime Exposure*$_{it}$ as the logarithm of the total exposure of bank *i* in a particular quarter *t* to the subprime lenders in the US. Again this information is taken directly from the credit register. We gathered information on the top 25 subprime lenders in the US which experienced difficulties during the US mortgage crisis. However, the German banks have been exposed to 18 of these top subprime lenders.[19] *US Subprime Exposure*$_{it}$ is accumulated across the individual exposures to subprime lenders in the US and therefore varies only by bank.

Finally, we define the *Log Conduit Exposure*$_{it}$ as the logarithm of the total amount of liquidity provided by bank *i* in a particular quarter *t* to its ABCP conduits. The information on the liquidity lines is taken from Moody's ABCP Query. *Log Conduit Exposure*$_{it}$ is accumu-

[18] In this respect we follow the recent literature (e.g., Jiménez et al. (2014), Ongena, Peydró and van Horen (2015)). By controlling for bank size we consider the relative importance of these exposures at the bank level. We also replace absolute exposures with relative exposures (Exposure over Capital) in unreported estimations. The results remain virtually unchanged.

[19] The 18 top subprime lenders have been identified in the credit register as borrower units. In total, 123 enterprises in the credit register belong to those 18 top subprime lenders.

lated across individual exposures to ABCP conduits and therefore varies again only by bank. Recall that the definition and measurement of bank exposures to financial shocks in the US and all other variables was summarized in Table 1.

3.4 Assessing Domestic Bank–Firm Lending In Germany

Our model explains the quarterly change in lending, representing the first difference of the logarithm of domestic lending:

$$\Delta \log \ Domestic \ \ Lending_{ijt} = \log\left(Domestic \ \ Lending_{ijt}\right) - \log\left(Domestic \ \ Lending_{ijt-1}\right) \quad (1)$$

where *Domestic Lending*$_{ijt}$ represents exposure of bank *i* to firm *j* in Germany in a particular quarter *t*.

If the exposures were fully repaid during the quarter, zero values are reported at the end of the quarter in the dataset. However, in our analysis we capture only non–zero exposures and therefore predominately focus on continuing changes in domestic lending, i.e., the “internal margin”.

We have around 3.9 million bank–firm–quarter observations to assess domestic lending by banks to firms. We note that average domestic lending in our sample appears to be much lower compared to the average US real estate exposure, the average subprime exposure and the average conduit exposure. This is the case because large banks in particular have such exposures.

Table 6 compares the number of observations for banks with and without exposures to the real estate sector, subprime or conduits. These sub–samples are not mutually exclusive. The sub–sample of banks with real estate exposure has over 1.4 million bank–firm–quarter observations of domestic lending. The average bank–firm level amount of domestic lending in this sub–sample equals €6 million and is somewhat larger than average domestic lending for the total sample. It should be mentioned that banks with conduit expo-

sures belong to the same sub–sample. However, a couple of banks have subprime exposures although they do not have real estate exposures.

[Table 6 Here]

The sub–sample of banks with subprime exposure provides us with 926,000 bank–firm–quarter observations of domestic lending. The average domestic lending for this sub–sample amounts to €5.7 million. Also a number of banks do have direct exposure to the US real estate sector and provide liquidity to conduits although they do not offer loans to subprime lenders.

We note that the number of banks that provide liquidity to conduits is significantly smaller compared to the sub–samples discussed before. The sub–sample of banks with conduit exposure provides us with only around 426,000 bank–firm–quarter observations of domestic lending. Similar to the sub–samples with direct exposure to the real estate sector and the one with subprime exposure, the average for domestic lending in this sub–sample, at €5.9 million, tends to be larger than the average for the total sample.

4. Explaining Domestic Bank–Firm Lending in Germany

4.1 Specifications

In Table 7 we run the growth in domestic bank lending in Germany on different types of exposures, starting with total US exposure (total exposure to the US real estate market), followed by a classification of our main variables of interest; US real estate exposure, US subprime exposure and conduit exposure, and various interactions that are introduced in

different models, for the sample that consists of the 1,664,262 bank–firm–quarter credit exposures.[20]

We are particularly interested in the interaction of the exposures with: (1) the change in US home prices to gauge the impact of this incoming shock on the volume of bank lending, on the one hand; and with (2) the change in US home prices and insolvency to gauge the impact of the incoming shock on the composition of bank lending, on the other hand.

We estimate different forms of the following specification:

$$\begin{aligned}\Delta\log \text{Domestic Lending}_{ijt} &= \beta_1 \log \text{Exposure}_{it\text{-}1} + \beta_2 \Delta\text{US Houseprices}_t + \beta_3 \text{Insolvency}_{jt\text{-}1} \\ &+ \beta_4 \log \text{Exposure}_{it\text{-}1} * \Delta\text{US Houseprices}_t + \beta_5 \log \text{Exposure}_{it\text{-}1} * \text{Insolvency}_{jt\text{-}1} \\ &+ \beta_6 \Delta\text{US Houseprices}_t * \text{Insolvency}_{jt\text{-}1} + \beta_7 \log \text{Exposure}_{it\text{-}1} * \Delta\text{US Houseprices}_t * \text{Insolvency}_{jt\text{-}1} \\ &+ \sum_{n=1}^{N} \beta_{8n} \text{Bank Controls}_{it-1n} + \alpha_i + \alpha_j + \varepsilon_{ijt}\end{aligned} \quad (2)$$

where Δ*log Domestic Lending*$_{ijt}$ is the growth of domestic lending (measured as the quarter–on–quarter logarithmic change in domestic lending by bank *i* to firm *j* in quarter *t*). In terms of exposure by German banks in the US, we distinguish between *Total US Exposure*$_{it-1}$, *US Real Estate Exposure*$_{it-1}$, *Subprime Exposure*$_{it-1}$ and *Conduit Exposure*$_{it-1}$. Δ*US Homeprices*$_t$ is the change in US home prices while *Insolvency*$_{jt-1}$ defines the firm insolvency rate and proxies for firm quality at the industry–region level. The bank controls we feature are: Size (log of total assets), Capital (leverage ratio), Liquidity (short term assets to total assets), ROA (return on assets), NPL (Non–performing loans to total loans), Deposits (deposits to total liabilities) and CB Funding (central bank funding to total assets).[21]

[20] This is the number of observations of the estimated model that includes all controls. Due to the very large number of firms and banks in the sample we follow customary Stata practice by demeaning first at the firm level and then "absorbing" the fixed effects at the bank level, thereby deflating the R–squares.

[21] We use the leverage ratio (total equity over total assets) as a measure of capital constraints. Using regulatory capital as an alternative measure does not affect the results. We also control for bank funding because banks that obtain financing from the wholesale market are found to have more problems during the crisis (de Haas and van Lelyveld (2014)).

All specifications include comprehensive sets of bank and also firm fixed effects (α_i and α_j).[22] ε_{ijt} is the error term.

[Table 7 Here]

We employ sets of three specifications for each exposure type, always starting with a simple model without any interactions, a second model with the interaction of exposure and US home prices, and a third model with the double and triple interactions with insolvency.

Each third specification, and also the final one which includes the triple interaction term, can help answer one of our main research questions: "Is there a flight to quality in bank lending in Germany when home prices in the US decline, and does the strength of this effect depend on the degree of the German banks' exposure to real estate, subprime and conduits in the US?

4.2 Control Variables

We start by discussing the estimated coefficients on the control variables, after which we turn to the coefficients of main interest on the double and triple interaction terms that include exposures.

Among bank control variables, most estimated coefficients have the expected sign but only the estimated coefficients on deposits and central bank funding are statistically significant. Representative estimates in this regard from Model 1, for example, equal 3.970*** and 6.737***, respectively.[23] These estimates imply that a one percentage point increase in the deposit ratio increases the growth in lending by 0.04 percentage points, and that a one percentage point increase in central bank funding increases it by 0.07 percentage

[22] Because we are mainly interested in the effect of bank–level exposures over time, including bank–time fixed effects is problematic. Because few firms in Germany rely on multiple banks that are differentiated by their exposures in the US, including firm–time fixed effects equally robs the estimations of most if not all of their relevant variation. We discuss these issues further in Subsection 4.4.

[23] *** Significant at 1 percent, ** significant at 5 percent, and * significant at 10 percent. For convenience we will also indicate the significance levels of the estimates that are mentioned further on in the text.

points.[24] For comparison; we note that the mean growth of domestic loans across all bank–firm–quarter observations equals –2.5 percent. These findings suggest that banks that rely on deposits and central bank funding increase lending to corporations. This is not surprising when taking into account the difficulties certain institutions faced in accessing wholesale markets as well as the ECB's willingness to provide liquidity. The rest of the control variables, although all imprecisely estimated, imply that smaller, capitalized, liquid and profitable banks increase lending which all corresponds to priors. The positive coefficient for the non–performing loans (also insignificant) can be attributed to a mechanical relationship since non–performing loans are reported in the credit register data and continue to exist until they are written off.

Next we discuss the estimated coefficients on the variables the exposures will be interacted with, i.e., the variable that captures the change in US home prices and the variable *Insolvency*. The coefficient for the change in US home prices is negative in all models ranging between –4.058 and –5.234. This implies that a 5 index point decrease in US home prices (which is the largest drop that is observed but one that occurs in more than one quarter of the observations) increases the growth in domestic lending maximum by 0.20 percentage points (= 0.05 x 4.058).

These estimates suggest that a substitution effect may be taking place whereby home price declines in the US *per se* may lead to more lending in Germany overall. However, the coefficient is imprecisely estimated. Although the magnitude of this effect is not that large, our estimates of coefficients on the double and triple interactions with this variable presented below may gain further credence as this substitution effect (as we will see) is overturned when banks have exposures in the US.

With respect to the insolvency ratio of the borrower's region and industry, it decreases the growth in lending as expected. The interaction term of the change in US home prices

[24] To make the reading of our results easier we multiple the estimated coefficients by 100.

and insolvency appears to have an inverse relationship with the change in lending. The coefficients for both terms are negative in all specifications but statistically insignificant.

4.3 Main Estimates on Exposures

Let us now turn to the exposures and their interactions. Before investigating the three types that are directly related to the origins of the crisis, we estimate our model with the total exposure to the US real estate market that is the sum of the three types. We observe in the first three models in Table 7 that an increase in total US exposure by itself does not have an impact on the growth in domestic lending. Its interaction with changes in US home prices, for which the coefficient is estimated to equal 0.978***, however implies that following a decrease by 5 index points in the S&P/Case–Shiller US National Home Price Index, a bank with a €1 billion total exposure to the US is estimated to contract its quarterly lending in Germany by 1.01 percentage points more than a bank with no such exposure. This is a large effect given that the mean (median) quarterly loan growth during the sample period equals –2.48 (–0.71) percent or when considering that going in 2 years from peak to trough in home prices in the US (i.e., a drop by 60 index points, or 12 times the 5 index points assessment provided above) by itself would result in an extra cut in credit of more than 12 percentage points for firms borrowing from these exposed banks. The lower panel in Table 7 further details the economic relevancy assessment calculations.[25] We also provide a vivid graphical illustration of these economic effects in Figures 2 and 3.

This is our first main finding: German bank exposure to the US real estate market, and the possible losses emanating there as real estate prices in the US sagged, substantially contracted bank lending in Germany. This presents a direct link in terms of credit volume.

Next, in Model 3 we interact insolvency as a measure of ex ante credit risk at the industry–region level with the aforementioned terms. The estimated coefficient on the double in-

[25] To assess economic relevancy, we rely on the amounts of €1 billion for total US exposure, real estate and conduit exposures and €100 million for subprime exposure. This choice ensures ease and clarity of exposition, but it also broadly respects the absolute and relative order of magnitudes of the standard deviations and means of the exposure variables (see Table 6). The standard deviation on real estate exposure equals €1 billion and on subprime €116 million. On conduits, the standard deviation equals €4.5 billion, while its mean equals €1.5 billion. Finally, recall that 5 index points in the S&P/Case–Shiller US National Home Price Index equals around two standard deviations for this index.

teraction term of exposure and insolvency equals –6.095*, while the estimated coefficient on the triple interaction term of exposure, US home prices and insolvency equals 312.665**. The triple interaction implies that, following a decrease by 5 index points in US home prices, a bank with a €1 billion Total US exposure contracts its quarterly lending to firms in Germany in riskier industry–region combinations (i.e., those with a 1 percentage point higher insolvency rate) by an additional 3.24 percentage points (=312.665 x Ln(1 billion) x 0.05 x 0.01/100) more than a bank with no such exposure.[26] Or, going in 2 years from peak to trough in home prices in the US by itself results in an extra cut in credit of almost 39 percentage points for riskier firms borrowing in Germany from these US real–estate exposed banks. This is a large cut in access to credit for these riskier firms that may be almost totally reliant on bank credit for their financing needs.

Hence, this is our second main finding: German bank exposure to the US real estate market overall and the possible losses emanating there as real estate prices in the US sagged, substantially shifted bank lending in Germany. A direct link in terms of credit composition, and clear evidence for a flight to quality.

Total US exposure is defined as the sum of the exposures to the US real estate market and consists of direct lending to the real estate sector and the subprime lenders, and the indirect conduit exposure. However, we would also like to focus on each particular type of exposure that is linked to different aspects of the problems in the real estate sector in the US. Therefore it is of great interest to examine a direct exposure to the US real estate sector in order to have a cleaner measure. We first observe in Models 4, 5 and 6 in Table 7 that US real estate exposure *per se* does not explain much of the changes in domestic lending, but that its interaction with US home prices in Model 5 strongly does. In the latter model, the estimated coefficient on the interaction equals 1.148***. This estimate implies that a bank with a €1 billion exposure to the US real estate sector, and following a decrease by 5 index points in the S&P/Case–Shiller US National Home Price Index, is esti-

[26] A one percentage point increase in default rates is often observed during bad times (Jacobson, Lindé and Roszbach (2013)). We have to divide by 100 here as we had earlier rescaled the coefficients by 100 for easier reading.

mated to contract its quarterly lending in Germany by 1.19 percentage points more than a bank with no such exposure.[27] This effect is slightly larger than the estimated coefficient in the previous set of exercises with total US exposure.

The coefficient on the double interaction term of exposure and insolvency has a larger magnitude (–5.702), however it is imprecisely estimated. The coefficient on the triple interaction term of exposure, US home prices and insolvency equals 386.937**. Following a decrease by 5 index points in US home prices, a bank with a €1 billion exposure to US real estate is estimated to contract its quarterly lending in Germany to riskier firms by an additional 4.01 percentage points more than a bank with no such exposure. This is clearly a larger economic effect compared to the one found for total exposure to the US real estate market suggesting that the direct link in terms of credit composition exists and may comprise a large part of the exposure effect.

In Models 7 to 9 in Table 7 we replace real estate with subprime exposure (which, as mentioned previously, is to subprime lenders and distinct from real estate exposure). All relevant estimated coefficients are imprecisely estimated probably due to the smaller amounts of exposures involved.

Yet, the signs of most coefficients are as expected. For example, the estimates in Model 9 imply that a bank with a €100 million exposure to subprime lenders, and following a decrease by 5 index points in US home prices, contracts its quarterly lending in Germany by 0.38 percentage points overall, and to riskier firms by 0.98 percentage points more than a bank with no such exposure. Hence once more credit volume and composition in Germany are affected by the possible losses that emanate from exposures combined with home price declines in the US.

Finally, in Models 10 to 12 in Table 7 we introduce conduit exposure, which is very large on average. Indeed, the liquidity potentially provided to conduits is three times as high as US real estate exposure on average, and much larger than the amount lent to

[27] Notice that for more than half the sample observations, the German banks involved have zero real estate exposure in the US, marking these banks to be at once a relevant and ideal control group.

subprime lenders in our sample. However, we do not find evidence to argue that conduit exposure itself has an impact on lending in Germany. Yet the estimates in Model 11 show that a contraction in domestic lending is again spurred by US home prices dropping. A bank with a €1 billion exposure cuts lending by 1.47 percentage points more following a decrease by 5 index points in US home prices than a bank with zero exposure.[28]

Finally, in Model 12 the estimated additional coefficients further imply that a bank with €1 billion in US conduits contracts its quarterly lending to riskier firms in Germany by 1.53 percentage points more than banks without conduits in place, with the additional home price effect resulting in a contraction of 3.43 percentage points.

In sum, credit volume and composition in Germany are affected by the possible losses that emanate from exposures, combined with US home price declines, on real estate, subprime and conduits in the US.

4.4 Further Controlling for Demand Effects

Our identification strategy relies on bank–time level variation in exposures in the US, coupled with firm fixed effects that account for firm–level demand in Germany. However, borrowers may potentially contract their expenditures and reduce their demand for loans over time. In order to show the change in the credit amount for the same firm borrowing from multiple banks as in Khwaja and Mian (2008), we have to control for time varying firm–level demand. Due to the lack of multiplicity in relationships, i.e., few German firms engage multiple banks that are differentiated by their exposures in the US, including firm–quarter fixed effects removes all the variation we are interested in. We employ two exercises to account for time varying firm–level demand.

First, we generate “firm–size times year” fixed effects (as in, e.g., Acharya et al. (2016), De Jonghe et al. (2016), De Jonghe et al. (2017)). We proxy firm size with the sum of total

[28] Conduits may not have entirely been invested in real estate or at all. For example, “credit arbitrage” ABCP conduits invested heavily in securitized assets, such as asset–backed securities backed by residential mortgages and commercial mortgages, and were consequently more exposed to subprime US residential mortgage loans than other types of conduits. Other ABCP conduits, such as “multi–seller” or “single–seller” conduits, had primarily funded unsecured receivables by the time the financial crisis arrived. It is currently impossible for us to distinguish between the different types of assets present in the conduits.

bank borrowing at firm level, and use the distribution of this variable to generate ten different percentile dummies. For each size percentile we then generate a set of year–specific fixed effects.

[Table 8 Here]

We note that we lose significance for the interaction terms of total exposure and US real estate exposure. However, we do observe a much stronger effect for the conduit exposure. Conduit exposure itself actually leads to a contraction in lending in Germany. This finding likely results from the sudden realization at the onset of the financial crisis that conduits "could come crashing back on the banks' balance sheets" (actually optimal given potential reputational losses in, e.g., Segura (2017)), and banks taking appropriate action in terms of lending in Germany.

The estimated coefficient of –0.349*** in Model 4 implies that a bank with €1 billion in US conduits is estimated to contract its quarterly lending in Germany by 7.23 percentage points more than banks without conduits in place. The double and triple interactions point to the same direction with larger magnitudes than previously estimated. However, the coefficient for the triple interaction is no longer statistically significant.

Following Schnabl (2012), we include only firms that borrow from at least three lenders and re–estimate our model with firm–year fixed effects to control for time–varying firm demand. We present the results in Table 9.

[Table 9 Here]

Our main finding remains unchanged: Banks with a higher exposure to the US real estate sector cut their lending to German firms by more following a decrease in US home prices than banks that do not have such exposure. In this sample, also banks with a higher subprime exposure cut back domestic lending when US home prices go down. Moreover,

we observe that increases in all types of exposures lead to an increased lending to less risky industry–region combinations. Finally, the triple interaction terms confirm the shift in lending for banks with higher total US exposure, real estate exposure and for banks that provided more liquidity to conduits.

4.5 Alternative Shock Measures

One may argue that our three measures of exposures may be related to different shocks that occurred at different points in time. For instance, the third quarter of 2007 can be considered as a specific shock to the ABCP market when risk–averse investors started to avoid purchasing these commercial paper instruments (Acharya and Schnabl (2010); Kacperczyk and Schnabl (2010)). However, we choose to employ a measure that flags problems the first and is also commonly considered the root cause of all ensuing problems, i.e., the turning point in home prices.

As a robustness test, we employ an alternative approach and replace our continuous variable of the change in home prices with two newly–created dummies. The first one, *Dummy Homeprices*, is equal to one after the second quarter of the year 2006, i.e., when home prices started to drop, and equal to zero otherwise. This dummy variable is interacted with the US real estate exposure and subprime exposure. The second dummy, *Dummy ABCP Market*, is equal to one after the second quarter of 2007, and equal to zero otherwise, and captures the shock to the banks with conduit exposures. As before we find that both measures negatively determine the change in lending. The interaction term of the *Dummy Homeprices* with the exposures is inversely related to domestic lending, and this time seems to matter for the subprime exposure too. In other words, banks with US real estate exposure and subprime exposure cut back lending once US home prices start to decline. All remaining coefficients of interest have the expected sign but imprecisely estimated possibly due to lower variation in the newly introduced dummies.

[Table 10 Here]

4.6 Alternative Explanations

4.6.1 Strategic Nature of German Bank Exposures in the US

Our identification strategy relies on the timing of the shock, i.e., the exogenous changes in US home prices, and how these interact with bank exposures to the US real estate market. But banks may have strategically chosen to expose themselves to the US real estate sector, subprime lenders and conduits. To deal with this issue we employ so far a strategy common in the literature by lagging bank exposures (*à la* Kashyap and Stein (2000) and Jiménez et al. (2012) for example). We also include bank fixed effects to mop all observable and unobservable time–invariant bank heterogeneity and many bank–level variables to account for as much time–varying bank heterogeneity as possible, in this way accounting for their risk taking incentives in the US real estate market as well. In this section we discuss what we do more.

First, we start by controlling for a regional Herfindahl–Hirschmann Index in Germany since regional bank competition can affect bank strategy in a time–varying manner. We present the mostly unaffected results in Table A1 in an Internet Appendix available online. Next, we tighten pre–determination by lagging bank exposures by four quarters rather than by one quarter to further mitigate any impact of anticipation banks may have. The unaffected results are in Table A2 in Appendix. Then, we instrument current exposures by past exposures and the one year lagged regional loan concentration (HHI). The unaffected results are in Table A3 in Appendix. Finally, we saturate specifications with bank–year fixed effects. Results are added to Table A3 as well.[29]

4.6.2 Bank Type

First, we account for spillovers to savings banks, which were indirectly exposed to subprime mortgages through their holdings in Landesbanks Puri, Rocholl and Steffen (2011).

[29] We acknowledge that, in this setting, it is very difficult to find an instrument that would satisfy the exclusion restrictions while being correlated with the endogeneous regressor. However we are confident that controlling for time varying bank heterogeneity takes care of these concerns.

This implies that a savings bank (without any exposure to the US real estate market itself) would cut back lending because of the Landesbank's risky portfolio. Our research design does not account for this type of transmission mechanism, as our exposure measures are bank specific. In other words, the control group may indeed include banks that are indirectly exposed to treatment. Although we aim to capture the initial shock, given the time period, spillovers to other banks may take place in our sample period, which may lead to an under–estimation of the impact. Therefore we exclude savings banks from the sample and re–estimate our model.

The results, presented in Appendix Table A4, support our previous findings. There is still the overall contraction in domestic lending following the US home price shock for banks with higher total US exposure, US real estate exposure and conduit exposure. Moreover, these banks then also shift their lending to less riskier industry–region combinations.

Next, we examine which exposed banks reduce lending and search for higher quality assets. We split our sample as 'well capitalized' and 'lowly capitalized banks' (with the split set at 50 percent) and re–estimate our model. The results imply that well capitalized and exposed banks cut back lending when US home prices start to decline. However exposed banks with lower capital levels display the 'flight to quality' behavior by reducing lending to riskier industry–regions following the decline in home prices. The results are presented in Table A5.

Finally, we consider the potential effects of a model–based regulation on credit risk as in Behn, Hasellmann and Vig (2014). We would like to rule out that our results are driven by the change in lending behavior by German banks with the introduction of the internal ratings–based regulation (IRB) where banks could choose between the new approach and the standard approach and get better risk weights. Information on IRB loans in the credit register is available after 2008. We employ IRB Share defined as IRB loans to total bank loan portfolio lagged by one quarter. We first control for this variable in our model, and

then interact it with the exposures, change in US home prices and the insolvency ratio to see if our initial results will be affected. While our main results with the double and triple interactions remain unchanged, we also observe that the IRB loans by banks with the US total exposure and US real estate exposure experience a further reduction following a decrease in US home prices (Table A6).

4.7 Impact on Firm Borrowing

So far, we have documented changes in the composition of domestic lending: Exposed banks cut their lending to domestic firms by more following a decrease in US home prices than banks that do not have such exposure. Moreover, these banks also shift their lending to safer industry–region combinations. We are also interested to see the consequences of the so–called "flight to quality" behavior; in other words, the indirect impact on the real activity. We investigate whether or not firms in riskier industry–region combinations are able to obtain funding from other banks when treated banks decrease lending to those firms. Similar to the approach in Schnabl (2012), we aggregate the data at the borrower firm level and explain total domestic borrowing with weighted bank exposures (weighted by the share of total borrowing from each lender).

[Table 11 Here]

Table 11 presents the estimation results that document a decrease in credit availability for borrowers of exposed banks when US home prices decline or when the borrowers belong to riskier industries and regions.[30] This is indicated specifically by the negative and significant coefficient for all exposure types. Moreover, firms borrowing from banks that are exposed to the US real estate sector experience a higher reduction in borrowing when US home prices go down. Also firms in riskier industry–region combinations that are engaged

[30] The number of observations is higher than for our bank–firm analysis because we take an expansive approach to missing observations in the original data by aggregating all available information at the firm level which is appropriate if data availability across firm–bank–quarter combinations is random (which we assess it to be).

with banks with exposures to subprime lenders and conduits have an additional reduction in total borrowing. This finding is also in line with Popov and Rocholl (2017) who document that borrowers of affected banks experienced a significant decline in employment and in labor compensation after the crisis.

5. Conclusion

Motivated by the seminal works of Peek and Rosengren (1997) and Peek and Rosengren (2000), we study the international transmission of shocks through the German banking sector during the last financial turmoil triggered by the subprime mortgage crisis. In particular, using unique German bank exposure data, we investigate how exposures to the US real estate market influenced domestic lending in Germany. We are interested in total bank exposure to the US real estate market and its three salient components: Direct exposures to the US real estate sector and to the subprime lenders in the US, and indirect exposure as liquidity provided to ABCP conduits.

Confirming previous studies on the transmission of shocks, we first document the overall contraction in lending in Germany following the home price shock. Our main aim is, however, to explore the heterogeneity in the contraction across banks and firms. In other words, we investigate whether differences in bank exposures to the US determine domestic lending in Germany when home prices started to decline in the US, and whether there is a 'flight to quality' in lending for those banks that were more exposed to the US real estate market.

We indeed find that banks with higher total exposure to the US real estate market and, in particular, with higher exposure to the US real estate sector and to conduits contract their lending to German firms more following a decrease in US home prices than banks with no such exposure. Moreover, these banks also prefer lending to industry–region combinations with lower insolvency ratios, especially following a decrease in US home prices.

To sum up, we mainly document that possible losses abroad shift bank lending at home where the size of the effect depends on the type and the degree of exposure the bank has.

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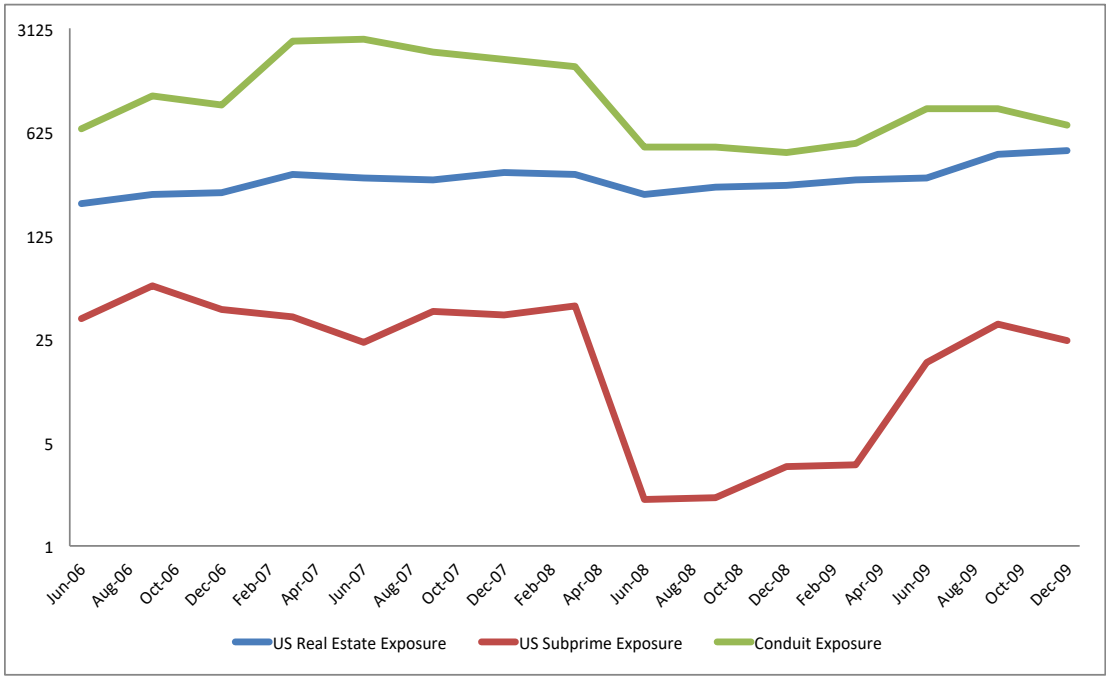
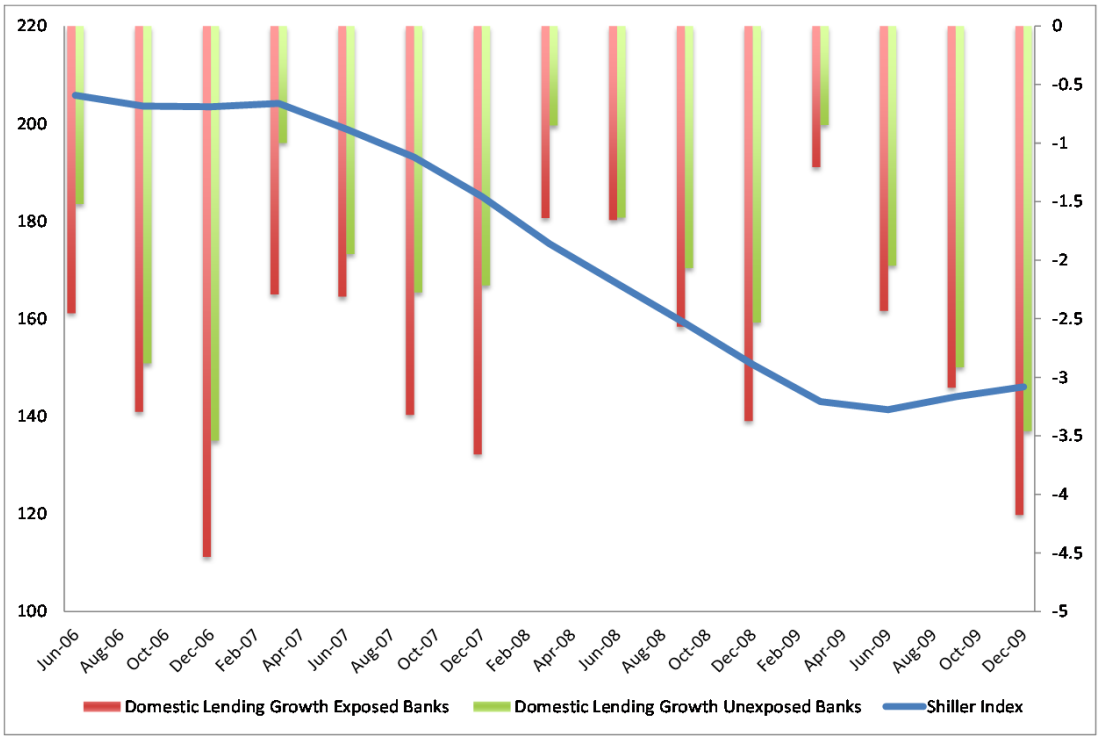
Figure 1
Panel A
Mean Bank Exposures over Time



The figure displays the mean values for US Real Estate Exposure, US Subprime Exposure and Conduit Exposure in € million (in logarithmic scale) .

Panel B
US Home Price Changes and Lending Growth in Germany



Domestic Lending Growth Exposed Banks and Unexposed Banks relate to the right axis, in percent, while the Shiller Index (with base year 2000) relates to the left axis, in index units.

Figure 2

Change in the Composition of Domestic Bank Lending in Germany by Bank Exposure in the US

The figure shows the difference in the change in domestic bank lending in Germany between banks that have the indicated exposure in the US and that have no such exposure. The differences are based on the estimates of the coefficients in Table 7 Models 3 (Total), 6 (Real Estate), 9 (Subprime) and 12 (Conduit). Only arrows in the lower panel that are starred represent coefficients that are statistically significant at the 10% level.

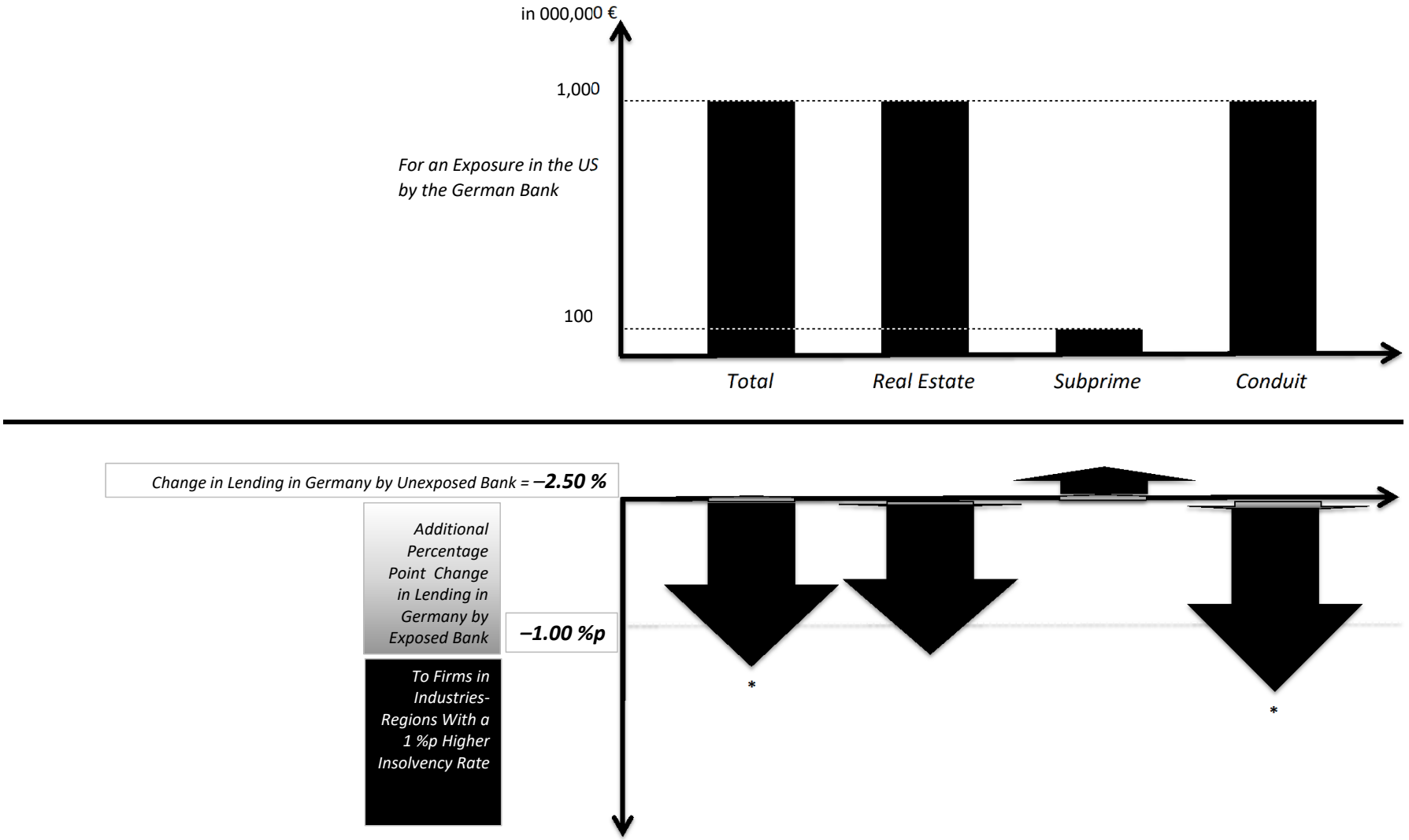
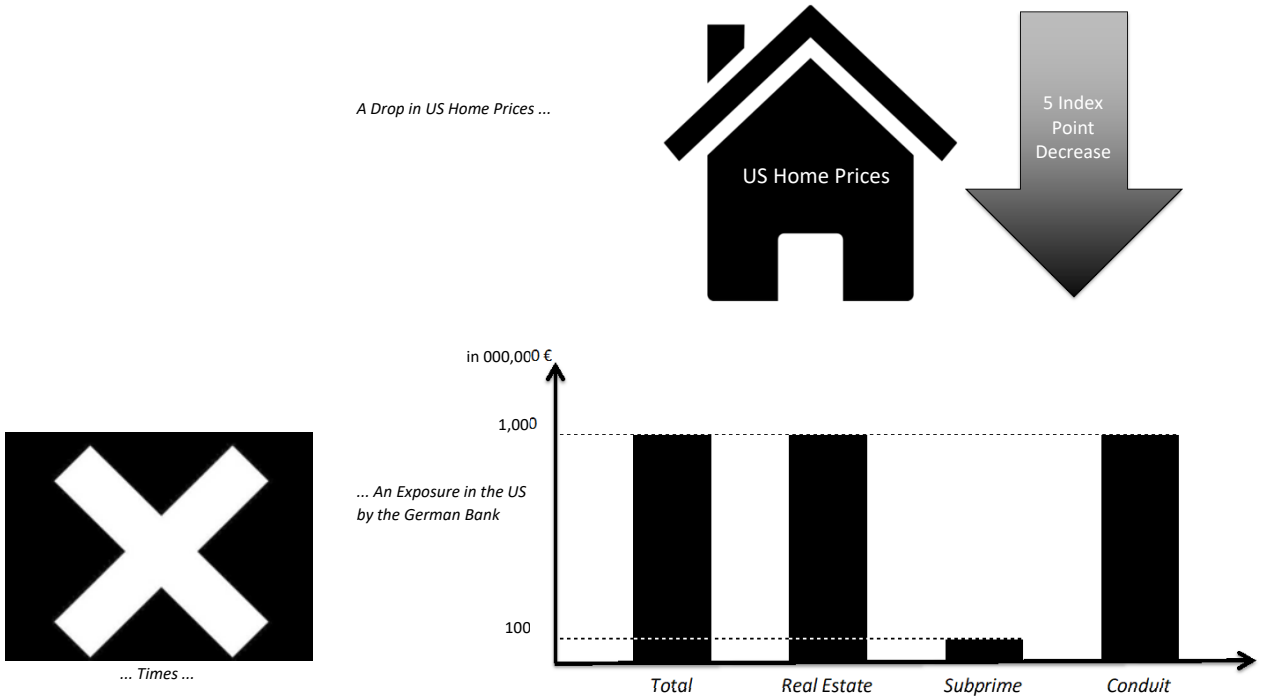


Figure 3

Change in the Composition of Domestic Bank Lending in Germany by Bank Exposure in the US Following a 5 Index Point Decrease in US Homeprices

The figure shows the difference in the change in domestic bank lending in Germany between banks that have the indicated exposure in the US and that have no such exposure following a 5 index point decrease in US homeprices. The differences are based on the estimates of the coefficients in Table 7 Models 3 (Total), 6 (Real Estate), 9 (Subprime) and 12 (Conduit). Only arrows in the lower panel that are starred represent coefficients that are statistically significant at the 10% level.



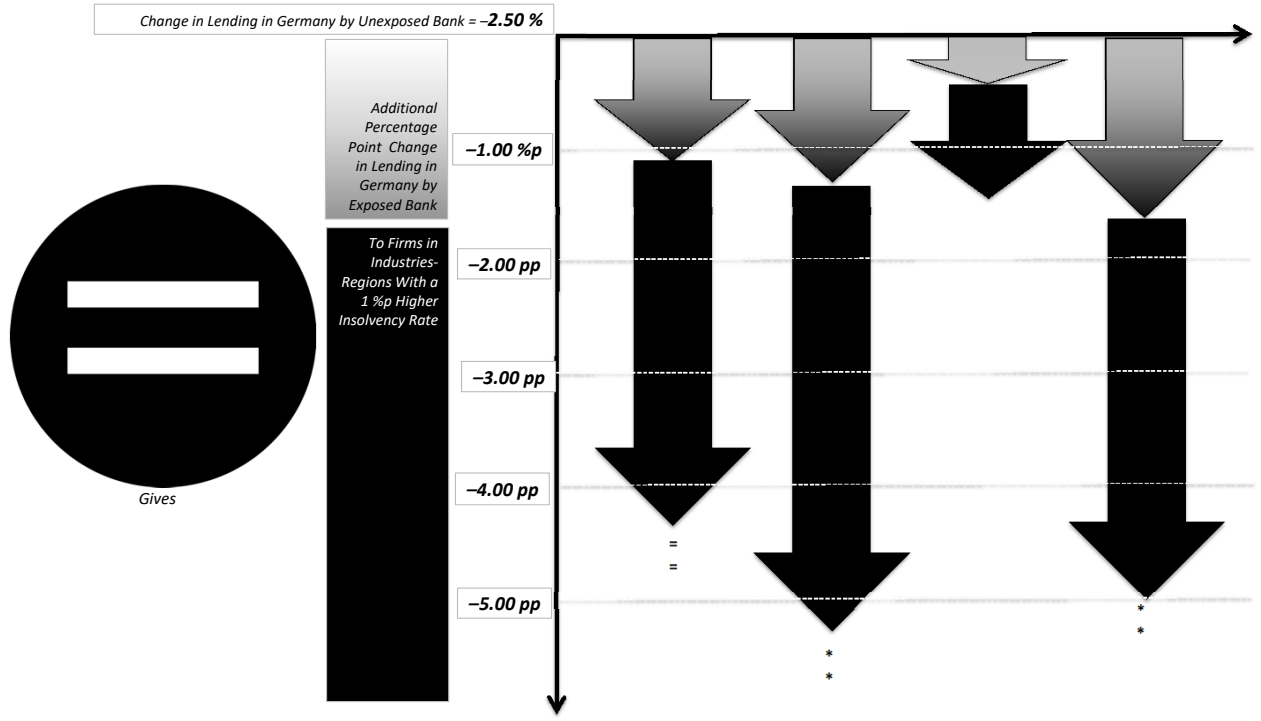


Table 1
Variable Definitions

Variable Name	Definition and Measurement	*Data Source*
Bank–firm level variable		
∆ Log Domestic Lending	The change in the natural logarithm of domestic lending from time t–1 to time t by bank i to firm j	*Bundesbank Credit Register*
Bank level variables		
Log US Real Estate Exposure	Natural logarithm of total direct exposure to the US real estate sector	*Bundesbank Credit Register*
Log US Subprime Exposure	Natural logarithm of total direct exposure to subprime lenders	*Bundesbank Credit Register*
Log Conduit Exposure	Natural logarithm of liquidity provided to asset–backed commerical paper (ABCP) conduits	*Moody's*
Size	Natural logarithm of total assets	*Bundesbank Bank Balance Sheet Data*
Capital	Capital ratio	*Bundesbank Bank Balance Sheet Data*
Liquidity	(Cash + balances with central banks + securities) to total assets	*Bundesbank Bank Balance Sheet Data*
ROA	Return on assets	*Bundesbank Bank Balance Sheet Data*
NPL	Non–performing loans to total loans	*Bundesbank Bank Balance Sheet Data*
Deposits	Deposits to total liabilities	*Bundesbank Bank Balance Sheet Data*
CB Funding	Central bank funding to total assets	*Bundesbank Bank Balance Sheet Data*
Macro variable		
∆ US Homeprices	The change in the national US home price index	*S&P/Case–Shiller Home Price Indices*
Firm industry–region variable		
Insolvency	The number of insolvencies divided by the total number of firms in an industry and region	*Destatis Insolvency Data & Turnover Tax Statistics*

This table provides the variable name, definition, measurement and data source. All variables are quarterly except ROA and NPL are available on a yearly basis.

Table 2
Descriptive Statistics for the Observations Used in the Regressions

Variable	Unit	Mean	Standard Deviation	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
All Banks								
Domestic Lending $_{t}$	€ million	3.83	14.67	0.11	0.49	1.58	3.24	7.58
Δ Log Domestic Lending $_{t}$	Logarithmic change	–0.025	0.341	–0.164	–0.036	–0.007	0.000	0.096
US Real Estate Exposure $_{t-1}$	€ million	370.30	981.40	0.00	0.00	0.00	86.74	1,309.28
Log US Real Estate Exposure $_{t-1}$	Logarithm	6.75	9.30	0.00	0.00	0.00	18.28	20.99
US Subprime Exposure $_{t-1}$	€ million	31.34	115.65	0.00	0.00	0.00	1.00	63.24
Log US Subprime Exposure $_{t-1}$	Logarithm	4.43	7.58	0.00	0.00	0.00	13.82	17.96
Conduit Exposure $_{t-1}$	€ million	1,469.02	4,536.33	0.00	0.00	0.00	0.00	4,472.07
Log Conduit Exposure $_{t-1}$	Logarithm	5.02	9.18	0.00	0.00	0.00	0.00	22.22
Total Assets $_{t-1}$	€ million	88,691.14	160,680.90	857.53	2,081.79	7,388.21	137,105.90	307,803.90
Size $_{t-1}$	Logarithm	23.25	2.23	20.57	21.46	22.72	25.64	26.45
Capital $_{t-1}$	Percentage	14.15	3.50	10.30	11.67	13.60	15.78	18.83
Liquidity $_{t-1}$	Percentage	7.98	5.35	2.08	4.03	7.12	10.69	14.92
ROA $_{t-1}$	Percentage	0.77	0.63	0.25	0.51	0.74	1.02	1.25
NPL $_{t-1}$	Percentage	4.55	3.56	1.23	2.40	4.04	6.03	8.19
Deposits $_{t-1}$	Percentage	23.75	15.24	0.61	9.98	25.97	35.19	42.59
CB Funding $_{t-1}$	Percentage	1.61	2.58	0.00	0.00	0.00	2.39	5.20
Δ US Homeprices $_{t}$	Index change (%)	–2.24	2.45	–5.22	–4.86	–2.6	–0.06	1.40
Insolvency $_{t-1}$	Percentage	0.24	0.21	0.06	0.11	0.20	0.31	0.46

This table provides the mean, standard deviation, 10th percentile, 25th percentile, median, 75th percentile and 90th percentile for all variables for the 1,664,262 observations used in the regressions. Δ Log Domestic Lending $_{t}$ is corrected for outliers at the 1 percentile level.

Table 3

Regional Distribution for Exposures by German Banks in 2007Q2

Type of Exposure	Unit	Total Exposure	Balance–Sheet Exposure	Off–Balance–Sheet Exposure	Derivatives
Real Estate Exposure					
Greece	€ million	284.64	269.77	14.88	0.35
Ireland	€ million	1,311.72	1,217.73	93.99	85.35
Portugal	€ million	1,715.69	1,593.12	122.57	0.55
Spain	€ million	10,613.89	9,215.53	1,398.36	28.21
Offshore Centers	€ million	13,625.11	12,193.87	1,431.23	982.51
US	€ million	31,041.15	27,337.69	3,703.47	265.95
All Foreign Countries	€ million	140,789.47	128,757.77	12,031.70	2,166.93
Banks					
US	€ million	156,898.31	84,979.48	71,918.83	56,381.09
Offshore Centers	€ million	147,931.56	96,858.99	51,072.58	27,016.96
Banks' Total Portfolio	€ million	5,350,873.61	3,707,425.18	1,643,448.43	651,867.36

This table provides the real estate exposures taken from the Bundesbank credit register for Greece, Ireland, Portugal, Spain, offshore centers, the US and for all foreign countries in 2007Q2 for all German banks, including the big banks and the Landesbanks. Additionally, it provides the exposure towards banks in the US, the exposure towards the offshore centers and the banks' total portfolio. The banks' total portfolio does not comprise exposures to international organisations. The table lists the total exposure, the balance–sheet exposure, the off–balance–sheet exposure and the derivatives calculated as the sum of all German banks in millions of euro. For offshore centers, the Bundesbank definition is used. According to this definition, offshore centers include 23 countries.

Table 4
Descriptive Statistics for Exposures by German Banks in the US in 2007Q2

Variable	Unit	Number of Observations	Mean	Standard Deviation	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
All Banks									
US Real Estate Exposure	€ million	1,547	17.67	195.49	0.00	0.00	0.00	0.00	0.00
US Real Estate Exposure / Total Assets	Percentage	1,547	0.02	0.31	0.00	0.00	0.00	0.00	0.00
US Subprime Exposure	€ million	1,547	1.26	19.35	0.00	0.00	0.00	0.00	0.00
US Subprime Exposure / Total Assets	Percentage	1,547	0.01	0.08	0.00	0.00	0.00	0.00	0.00
Conduit Exposure	€ million	1,547	81.30	1,270.32	0.00	0.00	0.00	0.00	0.00
Conduit Exposure / Total Assets	Percentage	1,547	0.02	0.32	0.00	0.00	0.00	0.00	0.00
Banks with US Real Estate Exposure	€ million	41	666.77	1,016.60	3.08	16.45	161.81	845.19	1,729.27
Banks with US Real Estate Exposure / Total Assets	Percentage	41	0.92	1.69	0.02	0.06	0.33	1.03	2.20
Banks with US Subprime Exposure	€ million	78	25.08	83.12	1.89	2.04	4.99	12.45	29.98
Banks with US Subprime Exposure / Total Assets	Percentage	78	0.27	0.27	0.02	0.05	0.18	0.42	0.68
Banks with Conduit Exposure	€ million	13	9,674.29	10,361.48	55.89	2,868.42	5,686.36	15,048.98	23,711.96
Banks with Conduit Exposure / Total Assets	Percentage	13	2.83	2.09	0.11	1.24	2.90	3.45	5.51

This table provides the real estate, subprime and conduit exposures in the US in 2007Q2 for all German banks, including the big banks and the Landesbanks. The table lists the number of observations, mean, standard deviation, 10th percentile, 25th percentile, median, 75th percentile and 90th percentile for all exposures in millions of euro.

Table 5

Panel A : Correlations between Exposures

	Log US Real Estate Exposure	Log US Subprime Exposure	Log Conduit Exposure
Log US Real Estate Exposure	1		
Log US Subprime Exposure	0.4894*	1	
Log Conduit Exposure	0.7735*	0.3984*	1

Panel B : Number of Banks by Exposure and Bank Type in 2007Q2

Bank Type	**Number of Observations**	
	with US Real Estate Exposure	*without US Real Estate Exposure*
All Banks	**41**	**1,506**
Commerical banks	20	139
Big banks	*5*	*0*
Regional banks	*5*	*130*
Mortgage banks	*10*	*9*
Public sector banks	16	442
Landesbanks	*11*	*1*
Savings banks	*5*	*441*
All Cooperative banks	5	925
Cooperative central banks	*2*	*0*
Cooperative banks	*3*	*925*
	with US Subprime Exposure	*without US Subprime Exposure*
All Banks	**78**	**1,469**
Commerical banks	14	145
Big banks	*1*	*4*
Regional banks	*8*	*127*
Mortgage banks	*5*	*14*
Public sector banks	41	417
Landesbanks	*8*	*4*
Savings banks	*33*	*413*
All Cooperative banks	23	907
Cooperative central banks	*0*	*2*
Cooperative banks	*23*	*905*
	with Conduit Exposure	*without Conduit Exposure*
All Banks	**13**	**1,534**
Commerical banks	4	155
Big banks	*4*	*1*
Regional banks	*0*	*135*
Mortgage banks	*0*	*19*
Public sector banks	*7*	451
Landesbanks	*7*	*5*
Savings banks	*0*	*446*
All Cooperative banks	2	928
Cooperative central banks	*2*	*0*
Cooperative banks	*0*	*928*

Panel A reports the correlations between exposure types, and the significance levels for a Pearson correlation test, while Panel B lists the number of observations of banks by exposure type and bank type in 2007Q2. * significant at 10%.

Table 6
Descriptive Statistics, by Bank Exposures

Variable	Unit	Number of Observations	Mean	Standard Deviation	Number of Observations	Mean	Standard Deviation
		Banks with US Real Estate Exposure			*Banks without US Real Estate Exposure*		
Domestic Lending	€ million	1,412,731	6.08	24.54	2,450,487	2.22	7.92
US Subprime Exposure	€ million	1,827,003	90.74	185.82	2,890,361	0.81	3.45
Conduit Exposure	€ million	1,827,003	4,798.17	7,605.05	2,890,361	0.00	0.00
Total Assets	€ million	1,826,999	271,374.60	215,268.00	2,889,950	7,842.87	13,472.22
Capital	Percentage	1,777,098	13.98	3.48	2,869,058	14.01	3.63
Liquidity	Percentage	1,826,946	7.14	4.51	2,767,824	8.23	5.68
ROA	Percentage	1,810,322	0.43	0.46	2,881,715	1.02	1.20
NPL	Percentage	1,810,322	2.95	2.37	2,881,063	5.36	5.46
Deposits	Percentage	1,438,295	5.94	7.78	2,601,426	30.12	12.33
CB Funding	Percentage	1,821,826	2.74	2.62	2,890,306	1.29	2.57
		Banks with US Subprime Exposure			*Banks without US Subprime Exposure*		
Domestic Lending	€ million	925,784	5.72	24.37	2,937,434	2.97	12.55
US Real Estate Exposure	€ million	1,157,278	1,216.53	1,584.37	3,560,086	190.70	684.35
Conduit Exposure	€ million	1,157,278	5,549.67	8,876.52	3,560,086	658.34	2,331.93
Total Assets	€ million	1,157,278	257,923.10	268,741.50	3,559,671	61,797.27	113,370.30
Capital	Percentage	1,124,986	13.68	3.28	3,521,170	14.10	3.66
Liquidity	Percentage	1,157,278	7.23	4.68	3,437,492	7.99	5.45
ROA	Percentage	1,156,479	0.46	0.39	3,535,558	0.91	1.14
NPL	Percentage	1,156,479	2.83	2.35	3,534,906	4.95	5.11
Deposits	Percentage	877,500	10.04	13.31	3,162,221	24.69	15.10
CB Funding	Percentage	1,157,278	2.32	2.68	3,554,854	1.70	2.66
		Banks with Conduit Exposure			*Banks without Conduit Exposure*		
Domestic Lending	€ million	914,750	5.89	25.82	2,948,468	2.93	11.68
US Real Estate Exposure	€ million	1,249,293	1,175.60	1,420.14	3,468,071	178.23	770.38
US Subprime Exposure	€ million	1,249,293	123.40	212.89	3,468,071	4.03	26.66
Total Assets	€ million	1,249,293	354,940.50	207,099.10	3,467,656	21,640.56	45,939.66
Capital	Percentage	1,241,699	14.89	3.44	3,404,457	13.67	3.56
Liquidity	Percentage	1,249,293	7.43	2.96	3,345,477	7.94	5.91
ROA	Percentage	1,241,258	0.38	0.39	3,450,779	0.94	1.14
NPL	Percentage	1,241,258	2.47	1.90	3,450,127	5.14	5.15
Deposits	Percentage	1,101,002	3.45	2.95	2,938,719	28.27	13.32
CB Funding	Percentage	1,249,293	2.68	1.91	3,462,839	1.55	2.85

This table provides the number of observations, mean and standard deviation for all bank–specific variables, by bank exposures, for the full sample.

Table 7
Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US

Model	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Log Exposure =	***Log Total US Exposure***			***Log US Real Estate Exposure***			***Log US Subprime Exposure***			***Log Conduit Exposure***		
Log Exposure $_{t-1}$	–0.006	0.003	0.001	–0.017	–0.007	–0.009	–0.003	0.001	0.001	–0.02	–0.006	–0.008
	[0.013]	[0.014]	[0.014]	[0.019]	[0.021]	[0.021]	[0.009]	[0.010]	[0.010]	[0.015]	[0.015]	[0.015]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$		0.978***	1.035***		1.148***	1.204***		0.416	0.402		1.414***	1.499***
		[0.288]	[0.292]		[0.332]	[0.343]		[0.338]	[0.350]		[0.434]	[0.437]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$			–6.095*			–5.702			1.330			–7.396*
			[3.593]			[4.177]			[4.317]			[4.169]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$			312.665**			386.937**			105.93			330.725*
			[143.579]			[156.078]			[201.079]			[171.839]
Δ US Homeprices $_{t}$	–5.169	–4.476	–4.398	–5.018	–4.155	–4.058	–5.168	–5.215	–5.16	–5.234	–4.308	–4.221
	[3.471]	[3.492]	[3.485]	[3.420]	[3.415]	[3.408]	[3.494]	[3.506]	[3.504]	[3.414]	[3.456]	[3.447]
Insolvency $_{t-1}$	–9.041	–8.259	–13.46	–9.061	–8.604	–13.76	–8.963	–8.785	–14.439	–9.206	–8.415	–12.453
	[19.557]	[19.625]	[19.828]	[19.558]	[19.603]	[20.064]	[19.556]	[19.580]	[18.963]	[19.542]	[19.633]	[20.199]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$			–766.254			–713.86			–962.887			–857.229
			[789.980]			[792.499]			[750.649]			[783.057]
Size $_{t-1}$	–0.041	–0.037	–0.038	–0.015	–0.01	–0.011	–0.053	–0.054	–0.054	–0.007	–0.005	–0.005
	[0.049]	[0.048]	[0.048]	[0.050]	[0.047]	[0.048]	[0.049]	[0.049]	[0.049]	[0.060]	[0.062]	[0.062]
Capital $_{t-1}$	7.679	7.749	7.705	7.293	7.261	7.250	7.798	7.885	7.890	8.057	8.105	8.062
	[7.346]	[7.291]	[7.295]	[7.482]	[7.411]	[7.409]	[7.030]	[7.007]	[7.007]	[7.137]	[7.087]	[7.079]
Liquidity $_{t-1}$	0.773	0.795	0.787	0.861	0.811	0.809	0.746	0.758	0.764	0.955	0.865	0.866
	[1.150]	[1.148]	[1.149]	[1.159]	[1.159]	[1.160]	[1.155]	[1.152]	[1.152]	[1.162]	[1.156]	[1.156]
ROA $_{t-1}$	16.157	15.478	15.811	15.157	14.343	14.56	16.941	17.113	17.222	14.452	14.187	14.536
	[24.206]	[24.866]	[24.831]	[24.461]	[24.862]	[24.862]	[23.304]	[23.122]	[23.144]	[23.546]	[24.746]	[24.729]
NPL $_{t-1}$	1.019	0.904	0.922	1.042	0.913	0.939	1.011	1.028	1.031	0.622	0.518	0.532
	[3.194]	[3.226]	[3.229]	[3.182]	[3.223]	[3.229]	[3.179]	[3.164]	[3.165]	[3.211]	[3.300]	[3.302]
Deposits $_{t-1}$	3.970***	4.032***	4.037***	3.829***	3.890***	3.893***	4.027***	4.044***	4.046***	3.800***	3.892***	3.891***
	[0.636]	[0.626]	[0.626]	[0.629]	[0.620]	[0.619]	[0.648]	[0.652]	[0.651]	[0.715]	[0.689]	[0.689]
CB Funding $_{t-1}$	6.737***	6.801***	6.813***	6.688***	6.712***	6.713***	6.767***	6.811***	6.799***	6.455***	6.258***	6.265***
	[1.950]	[1.977]	[1.977]	[1.939]	[1.953]	[1.955]	[1.941]	[1.965]	[1.966]	[2.012]	[2.022]	[2.021]
Constant	–2.003***	–1.986***	–1.978***	–2.011***	–1.993***	–1.986***	–2.000***	–2.000***	–1.992***	–2.010***	–1.980***	–1.972***
	[0.062]	[0.062]	[0.062]	[0.063]	[0.064]	[0.064]	[0.061]	[0.061]	[0.061]	[0.062]	[0.063]	[0.063]
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262
R–squared	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Difference in Change in Domestic Bank Lending in Germany Between Banks That Have the Indicated Exposure in the US and That Have No Such Exposure												
€1 Billion in Total US Exposure $_{t-1}$	–0.0012	0.0006	0.0002									
€1 Billion in US Real Estate Exposure $_{t-1}$				–0.0035	–0.0015	–0.0019						
€100 Million in US Subprime Exposure $_{t-1}$							–0.0006	0.0002	0.0002			
€1 Billion in Conduit Exposure $_{t-1}$										–0.0041	–0.0012	–0.0017
Additional Difference in Change in Domestic Bank Lending in Germany Following a 5 Index Point Decrease in US Homeprices Between Banks That Have the Indicated Exposure in the US and That Have No Such Exposure												
€1 Billion in Total US Exposure $_{t-1}$		**–0.0101**	**–0.0107**									
€1 Billion in US Real Estate Exposure $_{t-1}$					**–0.0119**	**–0.0125**						
€100 Million in US Subprime Exposure $_{t-1}$								–0.0038	–0.0037			
€1 Billion in Conduit Exposure $_{t-1}$											**–0.0147**	**–0.0155**
Additional Difference in Change in Domestic Bank Lending to Firms in Industries–Regions With a 1 %p Higher Insolvency Rate in Germany Between Banks That Have the Indicated Exposure in the US and That Have No Such Exposure												
€1 Billion in Total US Exposure $_{t-1}$			**–0.0126**									
€1 Billion in US Real Estate Exposure $_{t-1}$						–0.0118						
€100 Million in US Subprime Exposure $_{t-1}$									0.0024			
€1 Billion in Conduit Exposure $_{t-1}$												**–0.0153**
Additional Difference in Change in Domestic Bank Lending to Firms in Industries–Regions With a 1 %p Higher Insolvency Rate in Germany Following a 5 Index Point Decrease in US Homeprices Between Banks That Have the Indicated Exposure in the US and That Have No Such Exposure												
€1 Billion in Total US Exposure $_{t-1}$			**–0.0324**									
€1 Billion in US Real Estate Exposure $_{t-1}$						**–0.0401**						
€100 Million in US Subprime Exposure $_{t-1}$									–0.0098			
€1 Billion in Conduit Exposure $_{t-1}$												**–0.0343**

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Table 1 contains all variable definitions. In our estimations, the measurement for Insolvency, Capital, Liquidity, ROA, NPL, Deposits and CB Funding are in ratios. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table 8

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, Including Firm–Size–Year Fixed Effects

	Model	*1*	*2*	*3*	*4*
	Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
Log Exposure $_{t-1}$		0.002	0.003	–0.027	–0.349***
		[0.019]	[0.033]	[0.025]	[0.081]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$		–0.398	–0.67	–2.683	29.996***
		[0.788]	[1.435]	[1.731]	[4.409]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$		–0.891	5.928	2.738	–48.725***
		[7.595]	[13.393]	[5.870]	[11.480]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$		159.438	753.507	–363.427**	1,399.74
		[258.788]	[527.603]	[158.834]	[976.151]
Δ US Homeprices $_{t}$		–19.936***	–19.995***	–18.408***	–25.327***
		[3.057]	[3.025]	[2.919]	[3.629]
Insolvency $_{t-1}$		42.806***	41.395***	42.099**	51.491***
		[15.614]	[15.413]	[16.428]	[15.823]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$		–1,539.257**	–1,526.999**	–1,393.142**	–2,047.858***
		[654.163]	[640.504]	[663.835]	[551.940]
Constant		Yes	Yes	Yes	Yes
Bank Controls		Yes	Yes	Yes	Yes
Bank Fixed Effects		Yes	Yes	Yes	Yes
Firm Size–Year Fixed Effects		Yes	Yes	Yes	Yes
Observations		1,664,262	1,664,262	1,664,262	1,664,262
R–squared		0.028	0.028	0.028	0.028

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Table 1 contains all variable definitions. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table 9

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, Controlling for Firm Demand by Employing Only Firms with Multiple Lenders

	Model	*1*	*2*	*3*	*4*
	Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
Log Exposure $_{t-1}$		–0.042	–0.069**	0.028	–0.028
		[0.026]	[0.029]	[0.019]	[0.047]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$		2.361*	2.630**	3.776*	2.311
		[1.222]	[1.267]	[1.984]	[1.454]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$		–24.889***	–25.747***	–12.198*	–20.306**
		[7.391]	[8.042]	[7.237]	[8.080]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$		942.356***	1,042.101***	496.898	781.465*
		[330.766]	[348.612]	[496.908]	[426.614]
Δ US Homeprices $_{t}$		–9.192	–9.02	–12.246	–10.238
		[11.062]	[10.703]	[10.537]	[10.937]
Insolvency $_{t-1}$		56.455	63.568	75.819	62.51
		[66.827]	[70.657]	[54.839]	[67.405]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$		–775.084	–891.038	–1379.58	–962.619
		[3,295.780]	[3,390.294]	[3,268.091]	[3,435.433]
Constant		Yes	Yes	Yes	Yes
Bank Controls		Yes	Yes	Yes	Yes
Bank Fixed Effects		Yes	Yes	Yes	Yes
Firm–Year Fixed Effects		Yes	Yes	Yes	Yes
Observations		258,040	258,040	258,040	258,040
R–squared		0.003	0.003	0.003	0.003

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Table 2 contains all variable definitions. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table 10
Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, for Alternative Shock Measures

Model	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Log Exposure =	***Log US Real Estate Exposure***			***Log US Subprime Exposure***			***Log Conduit Exposure***		
Dummy Shock =	**Dummy Homeprices**			**Dummy Homeprices**			**Dummy ABCP Market**		
Log Exposure $_{t-1}$	–0.033*	–0.02	–0.019	0.012	0.047***	0.050***	–0.017	–0.016	–0.016
	[0.018]	[0.019]	[0.020]	[0.008]	[0.014]	[0.015]	[0.012]	[0.011]	[0.011]
Log Exposure $_{t-1}$ * Dummy Shock $_{t}$		–0.062*	–0.067*		–0.152***	–0.160***		–0.012	–0.014
		[0.034]	[0.035]		[0.041]	[0.045]		[0.028]	[0.028]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$			–6.006			–6.29			–6.442*
			[4.809]			[6.527]			[3.763]
Log Exposure $_{t-1}$ * Dummy Shock $_{t}$ * Insolvency $_{t-1}$			7.618			31.018			1.258
			[15.955]			[21.985]			[10.837]
Dummy Shock $_{t}$	–2.691***	–2.717***	–2.785***	–2.694***	–2.813***	–2.885***	–2.019***	–2.020***	–2.056***
	[0.220]	[0.214]	[0.216]	[0.222]	[0.238]	[0.242]	[0.234]	[0.231]	[0.234]
Insolvency t–1	–29.92	–30.101	–78.088***	–30.275	–30.206	–82.779***	–30.428	–30.505	7.059
	[19.760]	[19.741]	[23.128]	[19.833]	[19.749]	[23.573]	[19.769]	[19.715]	[20.499]
Dummy Shock $_{t}$ * Insolvency $_{t-1}$			228.977***			248.198***			–247.375***
			[65.552]			[68.088]			[51.922]
Size $_{t-1}$	–0.027	–0.025	–0.025	–0.120*	–0.123*	–0.124*	–0.067	–0.065	–0.066
	[0.057]	[0.056]	[0.056]	[0.064]	[0.065]	[0.065]	[0.072]	[0.073]	[0.073]
Capital $_{t-1}$	12.387*	12.311*	12.317*	14.676**	14.843**	14.899**	12.860*	12.781*	12.751*
	[7.331]	[7.323]	[7.325]	[7.033]	[7.004]	[7.007]	[7.176]	[7.103]	[7.095]
Liquidity $_{t-1}$	1.827	1.799	1.808	1.604	1.679	1.685	2.239**	2.208**	2.199*
	[1.148]	[1.150]	[1.148]	[1.166]	[1.172]	[1.170]	[1.133]	[1.125]	[1.122]
ROA $_{t-1}$	–3.509	–3.961	–4.142	0.917	3.132	2.819	1.379	1.225	1.392
	[25.002]	[24.841]	[24.808]	[25.343]	[24.141]	[24.223]	[24.668]	[24.644]	[24.555]
NPL $_{t-1}$	–2.08	–2.151	–2.19	–2.228	–2.397	–2.462	–1.501	–1.452	–1.53
	[3.030]	[3.039]	[3.037]	[3.087]	[3.025]	[3.024]	[3.018]	[2.999]	[2.991]
Deposits $_{t-1}$	2.760***	2.775***	2.752***	3.200***	3.122***	3.101***	2.491***	2.514***	2.501***
	[0.581]	[0.577]	[0.578]	[0.657]	[0.665]	[0.667]	[0.706]	[0.682]	[0.683]
CB Funding $_{t-1}$	7.717***	7.758***	7.746***	7.811***	7.801***	7.754***	5.543***	5.547***	5.514***
	[1.650]	[1.636]	[1.638]	[1.656]	[1.671]	[1.677]	[2.058]	[2.050]	[2.050]
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262
R–squared	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Dummy Homeprices is equal to one after the second quarter of the year 2006, i.e., when home prices started to drop, and equal to zero otherwise. Dummy ABCP Market, is equal to one after the second quarter of 2007, and equal to zero otherwise, and captures the shock to the banks with conduit exposures. Table 1 contains all other variable definitions. In our estimations, the measurement for Insolvency, Capital, Liquidity, ROA, NPL, Deposits and CB Funding are in ratios. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table 11

Impact on Firm Borrowing

	Model	*1*	*2*	*3*	*4*
	Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
Log Exposure $_{t-1}$		–0.342***	–0.446***	–0.156***	–0.480***
		[0.013]	[0.016]	[0.011]	[0.015]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$		0.276*	0.444***	–0.042	–0.076
		[0.158]	[0.166]	[0.209]	[0.170]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$		1.303	3.486	–4.714*	–6.256***
		[2.202]	[2.332]	[2.688]	[2.352]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$		75.956	74.564	14.659	4.695
		[54.746]	[57.972]	[72.890]	[60.301]
Δ US Homeprices $_{t}$		–15.396***	–14.673***	–13.166***	–16.370***
		[2.418]	[2.306]	[2.273]	[2.163]
Insolvency $_{t-1}$		–19.56	–32.532	21.626	48.980*
		[30.548]	[29.074]	[26.916]	[26.694]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$		–1,655.229**	–1,369.947**	–966.956	–703.299
		[720.092]	[666.075]	[660.651]	[607.805]
Constant		Yes	Yes	Yes	Yes
Bank Controls (aggregated)		Yes	Yes	Yes	Yes
Firm Fixed Effects		Yes	Yes	Yes	Yes
Year Fixed Effects		Yes	Yes	Yes	Yes
Observations		1,819,124	1,819,124	1,819,124	1,819,124
R–squared		0.140	0.141	0.140	0.141

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) aggregated at the firm level and an ordinary least squares estimation is used. Table 1 contains all other variable definitions. In our estimations, the measurement for Insolvency, Capital, Liquidity, ROA, NPL, Deposits and CB Funding are in ratios. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Appendix

Table A1

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, Controlling for Regional Competition

Model	*1*	*2*	*3*	*4*
Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
Log Exposure $_{t-1}$	0.001	–0.010	0.000	–0.009
	[0.014]	[0.021]	[0.010]	[0.015]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$	1.029***	1.199***	0.392	1.484***
	[0.293]	[0.345]	[0.344]	[0.440]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$	–6.142*	–5.745	1.266	–7.565*
	[3.594]	[4.176]	[4.348]	[4.163]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	310.638**	385.270**	102.23	326.546*
	[143.858]	[156.734]	[201.535]	[171.881]
Log Exposure $_{t-1}$ * HHI $_{t-1}$	0.147	0.551	0.897	0.824
	[0.913]	[1.011]	[1.542]	[1.096]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * HHI $_{t-1}$	41.697	30.165	45.745	67.782
	[47.671]	[53.483]	[46.640]	[54.434]
Δ US Homeprices $_{t}$	–4.599	–4.259	–5.373	–4.441
	[3.467]	[3.394]	[3.481]	[3.434]
Insolvency $_{t-1}$	–13.281	–13.535	–14.166	–12.285
	[19.798]	[20.044]	[18.975]	[20.196]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	–775.291	–722.433	–970.876	–861.911
	[787.862]	[790.699]	[747.339]	[781.125]
HHI $_{t-1}$	–9.08	–9.159	–9.883	–8.776
	[6.857]	[6.878]	[6.913]	[6.769]
Δ US Homeprices $_{t}$ * HHI $_{t-1}$	446.053**	437.156**	412.403**	446.059**
	[205.742]	[208.007]	[192.425]	[201.480]
Constant	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,664,262	1,664,262	1,664,262	1,664,262
R–squared	0.001	0.001	0.001	0.001

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Table 1 contains all variable definitions. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table A2

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, with Four Lags of Bank Exposures

Model	*1*	*2*	*3*	*4*
Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
Log Exposure $_{t-4}$	–0.004	–0.010	–0.020**	0.017
	[0.013]	[0.022]	[0.010]	[0.018]
Log Exposure $_{t-4}$ * Δ US Homeprices $_{t}$	0.872***	1.239***	0.532	1.143**
	[0.301]	[0.353]	[0.399]	[0.459]
Log Exposure $_{t-4}$ * Insolvency $_{t-1}$	–7.149**	–5.626	–5.107	–5.357
	[3.536]	[4.119]	[4.610]	[4.087]
Log Exposure $_{t-4}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	348.633**	421.766***	128.78	355.672**
	[139.772]	[159.586]	[198.047]	[166.560]
Δ US Homeprices $_{t}$	–4.429	–4.032	–5.210	–4.361
	[3.488]	[3.426]	[3.499]	[3.487]
Insolvency $_{t-1}$	–16.029	–14.001	–14.832	–11.799
	[19.858]	[20.173]	[19.173]	[19.916]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	–730.026	–670.592	–891.853	–808.022
	[786.038]	[791.588]	[770.479]	[796.296]
Constant	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,664,262	1,664,262	1,664,262	1,664,262
R–squared	0.001	0.001	0.001	0.001

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Table 1 contains all variable definitions. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table A3

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, Instrumental Variables Estimation and Bank–Year Fixed Effects

Model	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
Log Exposure $_{t-1}$	–0.025	–0.020	–0.017	–0.036	–0.009	–0.016	0.004	–0.016
	[0.020]	[0.026]	[0.043]	[0.033]	[0.012]	[0.018]	[0.012]	[0.014]
Log Exposure $_{t-1}$ * Δ US Homeprices $_t$	1.251***	1.460***	0.958	1.678***	0.477	0.672	–0.073	0.538
	[0.404]	[0.435]	[0.907]	[0.616]	[0.452]	[0.540]	[0.602]	[0.632]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$	–8.933**	–5.326	–28.469**	–3.421	–7.642**	–7.614**	1.162	–7.681**
	[4.133]	[4.449]	[12.141]	[4.901]	[3.573]	[3.668]	[3.153]	[3.407]
Log Exposure $_{t-1}$ * Δ US Homeprices $_t$ * Insolvency $_{t-1}$	342.135**	402.265**	567.842	314.483	306.913**	351.410**	154.714	264.594*
	[158.559]	[159.365]	[497.101]	[191.838]	[134.646]	[144.934]	[187.637]	[148.818]
Δ US Homeprices $_t$	–4.166	–3.719	–5.181	–4.12	0.383	0.648	0.290	0.206
	[3.609]	[3.511]	[3.619]	[3.557]	[4.257]	[4.277]	[4.125]	[4.171]
Insolvency $_{t-1}$	–4.594	–2.549	–2.142	–0.106	–44.838***	–45.393***	–45.911***	–41.708**
	[19.708]	[19.339]	[22.123]	[19.527]	[16.972]	[17.296]	[17.542]	[17.350]
Δ US Homeprices $_t$ * Insolvency $_{t-1}$	–406.89	–303.32	–98.805	–421.878	–825.953	–791.329	–823.465	–958.332
	[825.725]	[815.890]	[867.495]	[820.746]	[781.956]	[795.214]	[796.323]	[783.206]
Constant					Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes				
Bank–Year Fixed Effects					Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes				
Observations	1,550,945	1,550,945	1,550,945	1,550,945	1,664,262	1,664,262	1,664,262	1,664,262
R–squared	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending). In the first four models, an instrumental variable estimation is used. Log Total US Exposure, Log US Real Estate Exposure, Log US Subprime Exposure and Log Conduit Exposure are instrumented with their lags of one year and the one year lagged regional Herfindahl–Hirschman Index of the German banking market. In the last four models, an ordinary least squares estimation is used. Table 1 contains all variable definitions. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table A4

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, Excluding Savings Banks

	1	*2*	*3*	*4*
Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
Log Exposure $_{t-1}$	0.00902	–0.02168	0.00124	–0.01259
	[0.025]	[0.037]	[0.015]	[0.020]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$	1.08116**	1.06349**	0.07454	1.56213***
	[0.468]	[0.526]	[0.507]	[0.588]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$	–7.45529	–7.33312	3.90437	–9.62008*
	[4.747]	[5.554]	[5.241]	[5.006]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	409.64692*	418.32402*	115.71473	303.48627
	[226.655]	[234.251]	[254.753]	[257.333]
Δ US Homeprices $_{t}$	4.51103	4.78832	4.0369	4.12377
	[6.740]	[6.628]	[6.870]	[6.567]
Insolvency $_{t-1}$	–15.80917	–16.57883	–24.74615	–12.53831
	[26.709]	[26.897]	[26.398]	[28.100]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	–266.13393	–279.07627	–492.50132	–482.86938
	[1,085.685]	[1,092.914]	[977.681]	[1,117.735]
Constant	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	794,728	794,728	794,728	794,728
R–squared	0.001	0.001	0.001	0.001

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Table 1 contains all variable definitions. In our estimations, the measurement for Insolvency, Capital, Liquidity, ROA, NPL, Deposits and CB Funding are in ratios. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table A5

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, for a Sample Split Based on Bank Capital

Model	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*
Log Exposure =	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***	***Log Total US Exposure***	***Log US Real Estate Exposure***	***Log US Subprime Exposure***	***Log Conduit Exposure***
	Low Capital				High Capital			
Log Exposure $_{t-1}$	–0.01	–0.013	–0.008	–0.028**	0.008	–0.014	0.001	0.057***
	[0.022]	[0.026]	[0.019]	[0.014]	[0.014]	[0.023]	[0.014]	[0.019]
Log Exposure $_{t-1}$ * Δ US Homeprices $_t$	0.332	0.278	–0.742	0.813	1.301***	1.819***	1.190***	2.242***
	[0.391]	[0.487]	[0.566]	[0.504]	[0.321]	[0.398]	[0.456]	[0.519]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$	–5.729	–3.749	3.917	–6.813	–6.67	–8.837	–5.735	–10.847
	[4.940]	[5.641]	[5.565]	[5.018]	[5.696]	[7.013]	[6.957]	[7.826]
Log Exposure $_{t-1}$ * Δ US Homeprices $_t$ * Insolvency $_{t-1}$	419.559**	503.937**	199.161	366.457*	137.096	173.911	–299.686	167.974
	[185.596]	[211.841]	[239.102]	[198.678]	[227.650]	[260.560]	[306.835]	[333.290]
Δ US Homeprices $_t$	8.942	9.19	10.073	8.109	–12.137***	–11.225***	–13.498***	–11.120***
	[7.392]	[7.341]	[7.697]	[7.297]	[2.349]	[2.287]	[2.309]	[2.290]
Insolvency $_{t-1}$	–14.507	–18.951	–34.864	–10.363	–13.759	–17.806	–6.561	–20.192
	[25.521]	[25.791]	[27.348]	[25.171]	[33.006]	[33.761]	[30.209]	[30.840]
Δ US Homeprices $_t$ * Insolvency $_{t-1}$	–739.893	–799.486	–690.486	–807.085	–1353.678	–1296.381	–1,968.376*	–1279.984
	[1,005.612]	[1,007.834]	[882.583]	[1,074.083]	[1,283.119]	[1,338.838]	[1,114.385]	[1,156.988]
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	716,628	716,628	716,628	716,628	947,634	947,634	947,634	947,634
R–squared	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. Table 1 contains all variable definitions. In our estimations, the measurement for Insolvency, Capital, Liquidity, ROA, NPL, Deposits and CB Funding are in ratios. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table A6

Explaining the Change in Domestic Bank Lending in Germany Following Shocks to Exposures in the US, and the Use of Internal Models

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Log Exposure =	***Log Total US Exposure***		***Log US Real Estate Exposure***		***Log US Subprime Exposure***		***Log Conduit Exposure***	
Log Exposure $_{t-1}$	0.007	0.00509	–0.00095	–0.00297	–0.0002	–0.00163	–0.00196	0.00119
	[0.015]	[0.014]	[0.023]	[0.022]	[0.010]	[0.010]	[0.015]	[0.017]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$	0.97823***	0.99268***	1.12349***	1.17857***	0.49103	0.52459	1.41372***	1.59333***
	[0.278]	[0.275]	[0.311]	[0.286]	[0.342]	[0.346]	[0.420]	[0.409]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$	–5.92956*	–4.05534	–5.43828	–2.78622	1.3787	2.35195	–7.06601*	–5.9118
	[3.598]	[3.774]	[4.191]	[4.248]	[4.309]	[4.245]	[4.182]	[4.261]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	325.10072**	335.70385**	398.71946**	443.12213**	115.79313	205.86669	339.00083**	332.39975*
	[144.064]	[165.477]	[156.885]	[178.295]	[200.969]	[218.710]	[172.540]	[201.744]
Log Exposure $_{t-1}$ * IRB Share $_{t-1}$		–0.08375**		–0.09443**		–0.04352		0.00023
		[0.040]		[0.043]		[0.050]		[0.042]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * IRB Share $_{t-1}$		–2.98146***		–2.95363***		–1.45148		–1.06495
		[1.025]		[1.021]		[1.005]		[1.122]
Log Exposure $_{t-1}$ * Insolvency $_{t-1}$ * IRB Share $_{t-1}$		3.7415		3.02588		5.27365		–11.22156
		[12.099]		[13.548]		[14.540]		[12.077]
Log Exposure $_{t-1}$ * Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$ * IRB Share $_{t-1}$		356.42227		155.3879		–151.08772		120.94927
		[377.782]		[416.288]		[507.736]		[429.434]
Δ US Homeprices $_{t}$	–5.22956*	–4.51887	–4.95629	–4.24186	–5.98023*	–5.81353*	–4.98381	–4.62019
	[3.156]	[3.073]	[3.053]	[2.948]	[3.171]	[3.159]	[3.167]	[3.053]
Insolvency $_{t-1}$	–13.72029	–13.0777	–14.00409	–11.32533	–15.04075	–14.02091	–12.62593	–6.1002
	[19.939]	[18.942]	[20.177]	[18.859]	[19.066]	[20.216]	[20.275]	[19.375]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$	–767.32425	–993.63017	–714.7775	–729.28174	–975.98536	–1200.3916	–859.43846	–932.45579
	[787.190]	[907.818]	[790.996]	[919.422]	[747.683]	[858.974]	[780.583]	[874.090]
IRB Share $_{t-1}$	–0.86985**	–0.99210**	–0.84224**	–0.92725*	–0.91877**	–0.88224*	–0.81197**	–1.05264**
	[0.409]	[0.494]	[0.419]	[0.490]	[0.413]	[0.485]	[0.376]	[0.470]
Δ US Homeprices $_{t}$ * IRB Share $_{t-1}$		–5.78559		–6.22382		1.39726		–8.88572
		[10.912]		[10.678]		[9.794]		[11.500]
Insolvency $_{t-1}$ * IRB Share $_{t-1}$		–118.163		–135.98929*		–161.16039		–76.50652
		[87.273]		[77.854]		[101.611]		[88.289]
Δ US Homeprices $_{t}$ * Insolvency $_{t-1}$ * IRB Share $_{t-1}$		99.24952		–759.61757		2,069.59		292.95277
		[3,737.586]		[3,578.902]		[3,097.299]		[3,906.305]
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262	1,664,262
R–squared	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

The dependent variable is the quarter–on–quarter logarithmic change in domestic lending by banks to firms (Δ log Domestic Lending) and an ordinary least squares estimation is used. IRB Share is defined as the volume of IRB loans to the total bank loan portfolio. Table 1 contains all variable definitions. In our estimations, the measurement for Insolvency, Capital, Liquidity, ROA, NPL, Deposits and CB Funding are in ratios. Coefficients are listed in the first row, robust standard errors clustered at bank level are reported in the row below, and the corresponding significance levels are adjacent to the coefficient. "Yes" indicates that the set of fixed effects is included. *** Significant at 1%, ** significant at 5%, * significant at 10%.